Sam. F. B. Morse

# OUR COUNTRY'S WEALTH AND INFLUENCE.

SHOWN BY

TRACING IN HISTORICAL FORM FROM YEAR TO YEAR AND DECADE TO DECADE, FROM 1620 TO 1880, THE RAPID INCREASE OF POPULATION, AND PROGRESS IN THE DEVELOPMENT OF OUR VAST NATURAL AND INDUSTRIAL RESOURCES, INCLUDING TRAVEL AND TRANSPORTATION, LABOR-SAVING MACHINERY IN ALL BRANCHES OF INDUSTRY, EXTENSIVE MANUFACTURING INTERESTS, INVENTIONS WITHOUT NUMBER, MINING, INTERNAL TRADE, AGRICULTURE, SCIENTIFIC DISCOVERIES, GROWTH OF GREAT COMMERCIAL CENTERS, TELEGRAPH, TELEPHONE, ELECTRIC LIGHT, AND OTHER GREAT WEALTH-PRODUCING INTERESTS, ALSO OUR SYSTEM OF UNIVERSAL EDUCATION, FROM THE COMMON SCHOOL TO THE HIGHEST LITERARY AND SCIENTIFIC INSTITUTIONS, WITH VALUABLE MISCELLANEOUS AND TABULAR STATISTICS, GIVING NUMBERS, AMOUNTS, DATES, ETC.

DEMONSTRATING THAT WE HAVE ACHIEVED A POSITION OF EQUALITY WITH THE FOREMOST NATIONS OF THE CIVILIZED WORLD IN ONE HUNDRED YEARS OF INDEPENDENT NATIONAL EXISTENCE.

BY

*Eminent Literary and Scientific Writers, who have made their Respective Subjects a Special Study. EDUCATION, by Henry Barnard, LL.D.*

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ILLUSTRATED WITH FOUR HUNDRED INSTRUCTIVE ENGRAVINGS BY EMINENT ARTISTS.

EDITED BY

L. P. BROCKETT, A. M., M. D.,

Associate Editor of JOHNSON'S CYCLOPEDIAS. Author of Numerous other Valuable Works.



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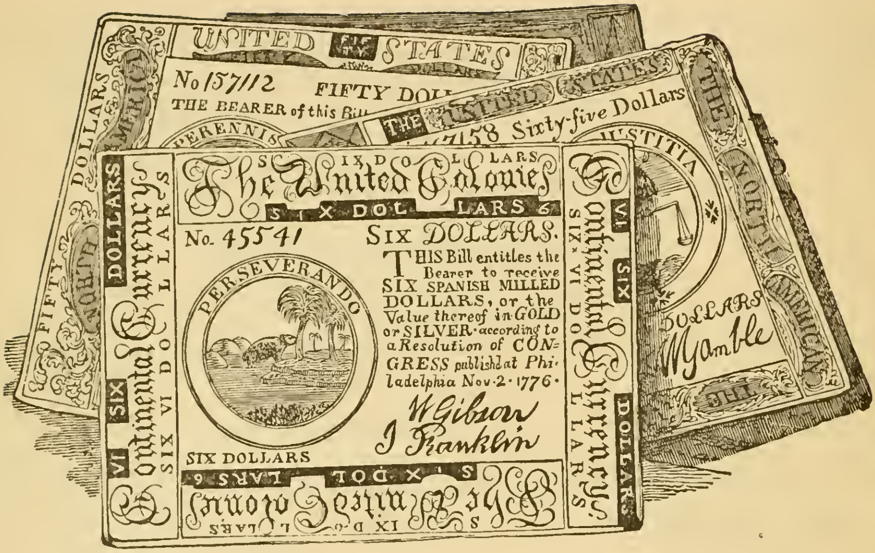


THIS ENGRAVING SHOWS THE BEST

Style of Bank Note Engraving in the time of the American Revolution.

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# PREFACE.

The subjects embraced in this volume are of the deepest interest to every American citizen, and to the students of history, political economy, and national progress, of every nation on the globe.

They furnish the materials for a more wonderful chapter in the world's history than has ever yet been written.

A people, in 1783, numbering less than three millions, of different nationalities, poor, oppressed by a heavy debt, just emerging from a ruinous war of seven years' duration, without national or much private capital, with no manufactures of importance, unskilled in agriculture, their commerce nearly ruined by the war, without mineral wealth, and with scanty means of education, with nothing, in short, but brave hearts, strong arms, ready wit, and an indomitable love of liberty, have, in a hundred years, made greater progress in agriculture, manufactures, the arts, in commerce, mining, education, and material prosperity and luxury, than any other nation on the surface of the earth has ever made in a thousand years. To-day, in population, wealth, influence, intelligence, and social position, they are the peers of any nation on the globe, and the superiors of most. What Great Britain, France, and Germany have attained through the painful experiences and vicissitudes of fifteen hundred years, they have easily equaled or surpassed in a single century, and as yet they have hardly passed the infantile stage of their development. What remains for them to accomplish in the next century, when their fifty millions shall have become four hundred millions; when the arable lands are all under plow, when every village of prairie or hillside or valley has its vast manufactories, and its commerce whitens every sea; when at eventide the electric light glows from every portion of the horizon, and makes the light of one day as the light of seven days; and the beneficent effects of education and a pure literature are universal,—we can only conjecture.

In attempting to chronicle the grand results already accomplished, the publisher has sought the advice of many eminent scholars and publicists. It has been a work of years to garner all these histories of our past national progress, and the most careful watchfulness and assiduous labor to bring the record as nearly as possible to the present moment. In this work he has employed many of the ablest writers of the country, and in its final collocation and revision has availed himself of the services of a cyclopædist who has been for twenty-six years engaged in these labors, and has attained the highest reputation for accuracy and carefulness in his researches. The subject of education has been committed to Hon. Henry Barnard, whose lifelong devotion to that cause and whose numerous writings on educational topics are known all over the world. Other subjects have been treated by eminent experts, and the whole brought up to 1881 or 1882 by the careful and critical labor of the editor. As it stands, the work will be invaluable to the farmer, the merchant, the banker, the scholar, the manufacturer, the mine owner, the professional man, the traveler, and the citizen of wealth and leisure, and not less so to the engineer, the machinist, the artisan, and the household which desires to know something of the land in which we dwell,—its rapid progress in the past, its glorious present, and its grand promise for the future.

If we are supposed to be a little enthusiastic on the subject, we are privileged to say that the solid merit of the work is endorsed by a large number of the best judges in the country.

A few words in relation to the expense of getting up this work. The public have no conception of the outlay on a work of this kind. Probably most people would think two or three thousand dollars an extravagant sum, and will be much surprised to learn that it required twenty thousand dollars, including the drawing and engraving of the illustrations, yet it will exceed rather than fall short of it. There are comparatively few farms or stocks of goods in country stores that involved so large an outlay as this book has required.

L. S.

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* United States, 1880.

# LIST OF ILLUSTRATIONS.

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# STATEMENT OF THE MILEAGE OF RAILROADS IN EACH STATE AND GROUP OF STATES, 1850 to 1880.

| Miles of R. R. in | 1880 | 1879 | 1878 | 1877 | 1876 | 1875 | 1874 | 1873 | 1872 | 1871 | 1870 | 1869 | 1868 | 1867 | 1866 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maine, | 1012 | 1009 | 1000 | 1000 | 1000 | 980 | 957 | 905 | 871 | 871 | 786 | 580 | 560 | 521 | 521 |
| New Hampshire, | 1019 | 1019 | 1009 | 964 | 943 | 934 | 918 | 877 | 810 | 790 | 736 | 702 | 667 | 667 | 667 |
| Vermont, | 909 | 873 | 873 | 872 | 810 | 810 | 778 | 721 | 710 | 675 | 614 | 614 | 605 | 587 | 587 |
| Massachusetts, | 1917 | 1870 | 1872 | 1863 | 1822 | 1817 | 1,786 | 1,755 | 1,658 | 1,606 | 1,480 | 1,480 | 1,425 | 1,401 | 1,331 |
| Rhode Island, | 217 | 210 | 208 | 204 | 188 | 179 | 173 | 159 | 136 | 136 | 136 | 125 | 125 | 125 | 125 |
| Connecticut, | 958 | 922 | 922 | 922 | 925 | 918 | 897 | 897 | 868 | 820 | 742 | 692 | 637 | 637 | 637 |
| N. England States, | 6032 | 5903 | 5884 | 5825 | 5688 | 5638 | 5,509 | 5,314 | 5,053 | 4,898 | 4,494 | 4,293 | 4,019 | 3,938 | 3,868 |
| New York, | 6049 | 6008 | 5879 | 5725 | 5493 | 5423 | 5,250 | 5,165 | 4,925 | 4,470 | 3,928 | 3,658 | 4,329 | 3,245 | 3,179 |
| New Jersey, | 1720 | 1663 | 1663 | 1661 | 1595 | 1511 | 1,438 | 1,418 | 1,378 | 1,265 | 1,125 | 1,011 | 973 | 942 | 879 |
| Pennsylvania, | 6274 | 6068 | 6011 | 5902 | 5796 | 5705 | 5,687 | 5,550 | 5,369 | 5,113 | 4,656 | 4,598 | 4,398 | 4,311 | 4,097 |
| Delaware, | 281 | 280 | 280 | 272 | 272 | 212 | 280 | 264 | 254 | 227 | 224 | 210 | 165 | 165 | 147 |
| Maryland & D. C., | 1007 | 966 | 952 | 944 | 944 | 929 | 1,060 | 1,046 | 1,012 | 820 | 671 | 588 | 535 | 527 | 484 |
| West Virginia, | 720 | 694 | 669 | 638 | 615 | 615 | 576 | 576 | 561 | 485 | 387 | 387 | 365 | 365 | 365 |
| Middle States, | 16051 | 15679 | 15454 | 15142 | 14715 | 14455 | 14,291 | 14,019 | 13,499 | 12,380 | 10,991 | 10,452 | 9,765 | 9,555 | 9,144 |
| Ohio, | 6146 | 5521 | 5151 | 4878 | 4736 | 4461 | 4,398 | 4,258 | 4,108 | 3,740 | 3,538 | 3,448 | 3,398 | 3,398 | 3,372 |
| Michigan, | 3962 | 3673 | 3593 | 3477 | 3492 | 3446 | 3,361 | 3,309 | 2,976 | 2,116 | 1,638 | 1,325 | 1,199 | 1,163 | 1,039 |
| Indiana, | 4497 | 1336 | 4398 | 4057 | 4035 | 3963 | 3,890 | 3,714 | 3,649 | 3,529 | 3,177 | 2,853 | 2,600 | 2,506 | 2,217 |
| Illinois, | 7920 | 7578 | 7148 | 7334 | 7167 | 7109 | 6,759 | 6,589 | 6,361 | 5,904 | 4,823 | 4,031 | 3,440 | 3,224 | 3,191 |
| Wisconsin, | 3132 | 2896 | 2810 | 2701 | 2690 | 2566 | 2,428 | 2,203 | 1,878 | 1,725 | 1,525 | 1,512 | 1,235 | 1,036 | 1,036 |
| Minnesota, | 3128 | 3008 | 2535 | 2194 | 2024 | 1990 | 1,990 | 1,950 | 1,906 | 1,612 | 1,092 | 795 | 572 | 482 | 298 |
| Iowa, | 5225 | 4779 | 4266 | 4131 | 3947 | 3850 | 3,765 | 3,728 | 3,643 | 3,160 | 2,683 | 2,095 | 1,523 | 1,283 | 998 |
| Kansas, | 3417 | 3103 | 2427 | 2352 | 2226 | 2150 | 2,150 | 2,100 | 2,063 | 1,760 | 1,501 | 931 | 648 | 494 | 240 |
| Nebraska, | 2011 | 1634 | 1344 | 1286 | 1219 | 1167 | 1,107 | 1,107 | 1,051 | 943 | 705 | 473 | 473 | 473 | 305 |
| Missouri, | 3998 | 3710 | 3286 | 3198 | 3015 | 2905 | 2,880 | 2,858 | 2,673 | 2,580 | 2,000 | 1,712 | 1,354 | 1,085 | 925 |
| Wyoming Ter., | 472 | 472 | 472 | 465 | 459 | 459 | 459 | 459 | 459 | 459 | 459 | 447 | 447 | 82 | |
| Utah, | 678 | 593 | 543 | 506 | 506 | 506 | 459 | 372 | 349 | 257 | 257 | 257 | | | |
| Dakota, | 1081 | 400 | 320 | 290 | 275 | 275 | 275 | 275 | 234 | 65 | | | | | |
| Colorado, | 1610 | 1208 | 1165 | 1045 | 961 | 807 | 682 | 603 | 483 | 328 | 157 | | | | |
| Indian Territory, | 275 | 275 | 275 | 275 | 277 | 275 | 279 | 279 | 279 | 92 | | | | | |
| New Mexico, | 628 | 118 | 8 | | | | | | | | | | | | |
| Western States, | 48118 | 43331 | 39841 | 38192 | 37029 | 35929 | 34,882 | 33,804 | 32,112 | 28,388 | 23,540 | 19,884 | 16,889 | 15,226 | 13,621 |
| Virginia, | 1919 | 1672 | 1616 | 1635 | 1618 | 1608 | 1,638 | 1,573 | 1,537 | 1,490 | 1,486 | 1,483 | 1,464 | 1,461 | 1,442 |
| North Carolina, | 1188 | 1416 | 1435 | 1426 | 1399 | 1356 | 1,315 | 1,265 | 1,250 | 1,190 | 1,178 | 1,130 | 1,097 | 1,042 | 1,042 |
| South Carolina, | 1155 | 1424 | 1439 | 1406 | 1352 | 1335 | 1,320 | 1,320 | 1,290 | 1,201 | 1,139 | 1,101 | 1,076 | 1,007 | 1,007 |
| Georgia, | 2517 | 2460 | 2415 | 2339 | 2306 | 2264 | 2,260 | 2,260 | 2,160 | 2,108 | 1,845 | 1,652 | 1,575 | 1,548 | 1,502 |
| Florida, | 554 | 519 | 487 | 485 | 481 | 484 | 484 | 466 | 466 | 466 | 466 | 466 | 437 | 437 | 416 |
| Alabama, | 1052 | 1832 | 1832 | 1802 | 1800 | 1800 | 1,722 | 1,722 | 1,628 | 1,496 | 1,157 | 916 | 953 | 851 | 839 |
| Mississippi, | 1140 | 1140 | 1126 | 1088 | 1028 | 1038 | 1,018 | 990 | 990 | 990 | 990 | 990 | 898 | 898 | 898 |
| Louisiana, | 611 | 544 | 466 | 466 | 466 | 466 | 539 | 539 | 539 | 539 | 479 | 375 | 335 | 335 | 335 |
| Texas, | 3250 | 2591 | 2128 | 2210 | 2073 | 1685 | 1,650 | 1,578 | 1,078 | 865 | 711 | 583 | 513 | 513 | 471 |
| Kentucky, | 1612 | 1595 | 1528 | 1509 | 1464 | 1326 | 1,326 | 1,320 | 1,266 | 1,123 | 1,017 | 852 | 813 | 635 | 581 |
| Tennessee, | 1725 | 1704 | 1665 | 1656 | 1638 | 1630 | 1,620 | 1,620 | 1,520 | 1,520 | 1,492 | 1,451 | 1,436 | 1,358 | 1,296 |
| Arkansas, | 878 | 808 | 783 | 767 | 789 | 740 | 700 | 700 | 450 | 258 | 256 | 128 | 86 | 38 | 38 |
| Arizona, | 220 | 220 | 80 | | | | | | | | | | | | |
| Southern States, | 19031 | 17732 | 17230 | 16789 | 16117 | 15712 | 15,602 | 15,353 | 14,112 | 13,446 | 12,196 | 11,107 | 10,693 | 10,126 | 9,867 |
| California, | 2232 | 2209 | 2149 | 2080 | 1848 | 1503 | 1,328 | 1,208 | 1,042 | 1,013 | 925 | 702 | 468 | 382 | 308 |
| Oregon, | 502 | 295 | 283 | 248 | 248 | 248 | 251 | 251 | 241 | 159 | 159 | 60 | 19 | 19 | 19 |
| Nevada, | 780 | 720 | 627 | 627 | 601 | 601 | 650 | 629 | 611 | 593 | 593 | 402 | 402 | 30 | |
| Washington Ter., | 293 | 212 | 212 | 197 | 110 | 110 | 110 | 105 | 65 | 25 | | | | | |
| Idaho Territory, | 383 | 183 | 27 | | | | | | | | | | | | |
| Pacific States, | 4390 | 3839 | 3378 | 3152 | 2807 | 2462 | 2,339 | 2,193 | 1,959 | 1,790 | 1,677 | 1,164 | 889 | 431 | 337 |

| Miles of R. R. in | 1865 | 1864 | 1863 | 1862 | 1861 | 1860 | 1859 | 1858 | 1857 | 1856 | 1855 | 1854 | 1853 | 1852 | 1851 | 1850 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maine, | 521 | 505 | 505 | 505 | 472 | 472 | 472 | 468 | 451 | 429 | 435 | 360 | 334 | 323 | 293 | 245 |
| New Hampshire, | 667 | 661 | 661 | 661 | 691 | 661 | 661 | 657 | 657 | 657 | 657 | 644 | 644 | 568 | 537 | 467 |
| Vermont, | 587 | 587 | 587 | 562 | 562 | 554 | 546 | 529 | 529 | 529 | 529 | 512 | 506 | 471 | 413 | 290 |
| Massachusetts, | 1,297 | 1,285 | 1,285 | 1,285 | 1,264 | 1,264 | 1,264 | 1,264 | 1,264 | 1,264 | 1,264 | 1,144 | 1,105 | 1,047 | 1,038 | 1,035 |
| Rhode Island, | 125 | 125 | 125 | 108 | 108 | 108 | 108 | 108 | 108 | 108 | 108 | 94 | 68 | 68 | 68 | 68 |
| Connecticut, | 637 | 630 | 630 | 630 | 630 | 601 | 601 | 590 | 590 | 590 | 496 | 496 | 496 | 496 | 451 | 402 |
| N. England States, | 3,834 | 3,793 | 3,793 | 3,751 | 3,697 | 3,660 | 3,652 | 3,618 | 3,599 | 3,577 | 3,469 | 3,250 | 3,153 | 2,973 | 2,800 | 2,508 |
| New York, | 3,002 | 3,821 | 2,792 | 2,728 | 2,700 | 2,682 | 2,679 | 2,661 | 2,651 | 2,629 | 2,583 | 2,534 | 2,387 | 2,031 | 1,623 | 1,361 |
| New Jersey, | 864 | 864 | 756 | 633 | 587 | 560 | 536 | 516 | 507 | 485 | 466 | 375 | 347 | 318 | 303 | 206 |
| Pennsylvania, | 3,728 | 3,360 | 3,771 | 3,006 | 2,802 | 2,598 | 2,442 | 2,340 | 2,081 | 1,925 | 1,800 | 1,537 | 1,404 | 1,372 | 1,297 | 1,240 |
| Delaware, | 134 | 127 | 127 | 127 | 127 | 127 | 127 | 127 | 115 | 79 | 56 | 44 | 39 | 39 | 39 | 39 |
| Maryland & D. C., | 416 | 408 | 408 | 408 | 386 | 386 | 277 | 352 | 352 | 327 | 327 | 327 | 327 | 327 | 274 | 259 |
| West Virginia, | 365 | 361 | 361 | 361 | 361 | 352 | 352 | 352 | 352 | 241 | 241 | 241 | 241 | 241 | 159 | 97 |
| Middle States, | 8,539 | 7,941 | 7,615 | 7,263 | 6,963 | 6,706 | 6,413 | 6,348 | 6,068 | 5,686 | 5,473 | 5,058 | 4,745 | 4,328 | 3,795 | 3,202 |
| Ohio, | 3,331 | 3,311 | 3,311 | 3,101 | 2,947 | 2,946 | 2,812 | 2,651 | 1,895 | 1,807 | 1,486 | 1,317 | 1,200 | 756 | 588 | 575 |
| Michigan, | 941 | 898 | 898 | 853 | 840 | 779 | 737 | 642 | 602 | 501 | 474 | 444 | 431 | 431 | 379 | 342 |
| Indiana, | 2,217 | 2,195 | 2,175 | 2,175 | 2,175 | 2,163 | 2,014 | 1,995 | 1,895 | 1,807 | 1,406 | 1,317 | 1,209 | 756 | 558 | 228 |
| Illinois, | 3,157 | 3,156 | 3,156 | 2,998 | 2,917 | 2,790 | 2,781 | 2,730 | 2,502 | 2,235 | 887 | 778 | 759 | 412 | 271 | 111 |
| Wisconsin, | 1,010 | 1,010 | 990 | 961 | 933 | 905 | 826 | 647 | 630 | 276 | 187 | 97 | 71 | 71 | 50 | 20 |
| Minnesota, | 213 | 157 | 31 | | | | | | | | | | | | | |
| Iowa, | 891 | 805 | 792 | 731 | 701 | 655 | 533 | 379 | 344 | 254 | 68 | | | | | |
| Kansas, | 40 | 40 | | | | | | | | | | | | | | |
| Nebraska, | 122 | | | | | | | | | | | | | | | |
| Missouri, | 925 | 925 | 868 | 838 | 838 | 817 | 724 | 517 | 318 | 144 | 139 | 38 | 38 | | | |
| Wyoming Ter., | | | | | | | | | | | | | | | | |
| Utah, | | | | | | | | | | | | | | | | |
| Dakota, | | | | | | | | | | | | | | | | |
| Colorado, | | | | | | | | | | | | | | | | |
| Indian Territory, | | | | | | | | | | | | | | | | |
| New Mexico, | | | | | | | | | | | | | | | | |
| Western States, | 12,847 | 12,497 | 12,221 | 11,657 | 11,320 | 11,064 | 10,427 | 9,595 | 8,186 | 7,024 | 4,567 | 4,001 | 3,708 | 2,426 | 1,846 | 1,276 |
| Virginia, | 1,407 | 1,379 | 1,379 | 1,379 | 1,379 | 1,379 | 1,301 | 1,168 | 1,137 | 951 | 912 | 839 | 752 | 632 | 520 | 384 |
| North Carolina, | 984 | 984 | 984 | 937 | 937 | 937 | 937 | 849 | 733 | 694 | 582 | 572 | 420 | 351 | 283 | 283 |
| South Carolina, | 1,007 | 973 | 973 | 973 | 973 | 973 | 973 | 905 | 879 | 848 | 759 | 669 | 652 | 598 | 378 | 289 |
| Georgia, | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 | 1,371 | 1,297 | 1,242 | 1,165 | 1,020 | 983 | 962 | 930 | 795 | 643 |
| Florida, | 416 | 402 | 402 | 402 | 402 | 402 | 290 | 198 | 128 | 56 | 21 | 21 | 21 | 21 | 21 | 21 |
| Alabama, | 805 | 805 | 805 | 805 | 743 | 743 | 628 | 532 | 532 | 454 | 334 | 304 | 304 | 214 | 183 | 183 |
| Mississippi, | 898 | 862 | 862 | 862 | 862 | 862 | 698 | 604 | 483 | 413 | 278 | 222 | 96 | 96 | 75 | 75 |
| Louisiana, | 335 | 335 | 335 | 335 | 335 | 335 | 295 | 281 | 261 | 249 | 203 | 198 | 89 | 80 | 80 | 80 |
| Texas, | 465 | 451 | 451 | 451 | 392 | 307 | 284 | 205 | 157 | 71 | 40 | 32 | | | | |
| Kentucky, | 567 | 567 | 567 | 567 | 549 | 534 | 534 | 458 | 305 | 268 | 242 | 242 | 167 | 94 | 94 | 78 |
| Tennessee, | 1,296 | 1,296 | 1,253 | 1,253 | 1,253 | 1,253 | 963 | 888 | 770 | 541 | 466 | 329 | 291 | 185 | 112 | |
| Arkansas, | 38 | 38 | 38 | 38 | 38 | 38 | | | | | | | | | | |
| Arizona, | | | | | | | | | | | | | | | | |
| Southern States, | 9,632 | 9,511 | 9,468 | 9,422 | 9,283 | 9,182 | 8,274 | 7,386 | 6,627 | 5,707 | 4,857 | 4,411 | 3,754 | 6,181 | 2,541 | 2,035 |
| California, | 214 | 147 | 53 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 8 | | | | | |
| Oregon, | 19 | 19 | 19 | 4 | | | | | | | | | | | | |
| Nevada, | | | | | | | | | | | | | | | | |
| Washington Ter., | | | | | | | | | | | | | | | | |
| Idaho Territory, | | | | | | | | | | | | | | | | |
| Pacific States, | 233 | 166 | 73 | 27 | 23 | 23 | 23 | 23 | 23 | 23 | 8 | — | — | — | — | — |

## RECAPITULATION.

| Groups or Sections. | 1880 | 1879 | 1878 | 1877 | 1876 | 1875 | 1874 | 1873 | 1872 | 1871 | 1870 | 1869 | 1868 | 1867 | 1866 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. England States, | 6032 | 5903 | 5884 | 5825 | 5688 | 5638 | 5,509 | 5,314 | 5,053 | 4,898 | 4,494 | 4,301 | 4,019 | 3,938 | 3,868 |
| Middle States, | 16051 | 15679 | 15454 | 15142 | 14715 | 14455 | 11,291 | 11,019 | 13,499 | 12,380 | 10,991 | 10,752 | 9,765 | 9,555 | 9,144 |
| Western States, | 48118 | 43331 | 39841 | 38192 | 37029 | 35929 | 34,882 | 33,804 | 32,112 | 28,269 | 23,540 | 19,884 | 16,889 | 15,226 | 13,621 |
| Southern States, | 19253 | 17952 | 17310 | 16789 | 16117 | 15712 | 15,602 | 15,353 | 14,112 | 13,246 | 12,196 | 11,107 | 10,683 | 10,126 | 9,867 |
| Pacific States, | 4170 | 3619 | 3298 | 3152 | 2807 | 2462 | 2,339 | 2,193 | 1,959 | 1,765 | 1,677 | 1,164 | 889 | 431 | 327 |
| Grand total, | 94622 | 86487 | 81837 | 79100 | 76656 | 74096 | 72,623 | 70,683 | 66,735 | 60,568 | 52,898 | 17,208 | 42,255 | 39,276 | 36,827 |

| Groups or Sections. | 1865 | 1864 | 1863 | 1862 | 1861 | 1860 | 1859 | 1858 | 1857 | 1856 | 1855 | 1854 | 1853 | 1852 | 1851 | 1850 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. England States, | 3,834 | 3,793 | 3,793 | 3,751 | 3,697 | 3,660 | 3,652 | 8,616 | 3,599 | 3,577 | 3,469 | 8,250 | 3,153 | 2,973 | 2,800 | 2,508 |
| Middle States, | 8,539 | 7,941 | 7,635 | 7,263 | 6,963 | 6,706 | 6,413 | 6,348 | 6,068 | 5,586 | 5,473 | 5,058 | 4,745 | 4,328 | 3,795 | 3,202 |
| Western States, | 12,847 | 12,497 | 12,221 | 11,657 | 11,320 | 11,064 | 10,427 | 9,495 | 8,186 | 7,024 | 4,567 | 4,001 | 3,708 | 2,126 | 1,846 | 1,276 |
| Southern States, | 9,632 | 9,531 | 9,468 | 9,422 | 9,283 | 9,182 | 8,274 | 7,386 | 6,627 | 5,707 | 4,857 | 4,411 | 3,754 | 3,181 | 2,541 | 2,035 |
| Pacific States, | 233 | 166 | 73 | 27 | 23 | 23 | 23 | 23 | 23 | 23 | 8 | | | | | |
| Grand total, | 35,085 | 33,908 | 33,170 | 32,120 | 31,286 | 30,635 | 28,789 | 26,968 | 21,503 | 22,016 | 18,371 | 16,720 | 15,360 | 12,908 | 10,982 | 9,021 |

# TRAVEL AND TRANSPORTATION.

## CHAPTER I.

### EARLY ROADS—POST ROADS—MACADAM—NATIONAL.

Of all the marvels that have marked the present century, those which manifest themselves in the development of the means of locomotion and transportation are among the most wonderful. With the emancipation of the states from their colonial condition, and the formation of a federal government, a most extraordinary activity seems to have been imparted to the inventive faculties of the American people, and to which side soever we direct our attention, we find that all the great and useful creations of genius take date from that auspicious event. The art of transportation has, as it were, been created. Not that our fathers were not possessed of the means of transportation by land or water, but those means were so immeasurably below those now in use, that it may be fairly claimed that a new art has been created. When our fathers landed on these shores, it is easily understood that they found no roads, or carriages, or other means of moving from one place to another. Indeed, the countries they had left were at that time but poorly provided with such means, as compared with what they have at present.

The first attempts to exchange the products of labor, which mark the nascent commerce of a people emerging from barbarism, are developed through manual labor, and the application of the strength of animals in a rude and imperfect way. The peddler with his pack, and progressively his pack-horse, are the instruments of intercourse in an infant society. From village to village, pathways are formed, wheel-carriages are invented to gather the fruits of harvests, and they wear their own paths upon the surface of the soil, and finally the road is constructed, more or less perfect, as a means of transport between places more or less distant. In such a state of affairs the roads are very imperfect, and the carriages of the rudest description. It is conceivable that the first step from the pack-horse and its pathway, to the two-wheeled cart and a road was a very great advance—nearly as much as from the road to the railway. And this improvement has by no means been of so distant a date as at first we might imagine. Not only is the construction of good roads of very recent date, but up to 1860 a very large portion of the world called civilized was without them. Certain parts of Europe, the French colony of Algiers, and the United States, alone possessed them. Until within the past twenty-five years, Russia, with more than 72 millions of inhabitants, Italy, with 27 millions, and Spain, with 23 millions, were almost wholly without any good roads. The diligences of Spain and Italy were dragged over the hills and through the valleys, by rough and detestable highways, while in Russia travel was only possible in winter on sledges. Now they have some good roads, and Russia has about 14,000 miles of railroad; Italy, 6,000, and Spain, 5,000.

The condition of affairs in this country before the construction of roads is evident to the hardy pioneers of the western frontier, and has been at times common to every part of the country. The first settlers on arriving here, it is certain, found no roads, and were not skilled in following an Indian trail. They built their houses upon the summits of hills, as well to avoid the miasmata of swamps as to get notice of the approach of hostile savages. The connection between these houses was by foot-paths that became horse tracks, and with the progress of events were enlarged into wagon roads. These, ultimately fenced in, became the highways, running irregularly over the face of the country, as they were prolonged by settlements. The science of road making never guided their direction, nor would farmers permit the squareness of their fields to give place to the straightness of roads. These highways were made in the general idea of making the passage of a vehicle between any two given points possible, and various expedients were resorted to, to overcome obstacles at the smallest expense. The plough turned up the sides, and the scraper drew the earth to the summit, which was levelled off to be hardened by travel. The reduction of hills or the filling in of swamps was not resorted to in new settlements, but the latter were mostly made passable by laying down logs across the track, and parallel with each other. This (*corduroy*) road was better than a swamp, but offered so great resistance that a far less load could be drawn over it than over a smooth, level road. The roads of the whole country took their character from their location, and transportation in each district was more or less difficult, according to circumstances. The best roads of the day were such as would now nowhere be tolerated; as a general thing, the water-courses, so abundant in this country, were the main arteries, and most roads were directed toward these, or in the neighborhood of a large city they converged upon it as a common centre.

The number of even these roads at the date of the formation of the government was not large, nor was their quality to be admired. The streams and water-courses were well supplied with small craft, that delivered goods and produce between distant points, but where the route left the water, the transportation became difficult and expensive. The war and its success had deeply stirred the public mind, and imparted full activity to the independent genius and enterprise of the people. Those 3,000,000 of souls occupied, as it were, but a foothold on this immense continent, to the ultimate possession of the whole of which they already looked forward. The means of transportation were the first object and desire that presented themselves to thinking men. Steam, as a power of locomotion, was unknown, and the science of road making little developed. Canals, therefore, presented themselves almost simultaneously to leading men in various sections. General Washington had, before he attained his twenty-first year, crossed the mountains and given his careful attention as an engineer to the subject of canals, more particularly the connection of the Chesapeake with the Ohio river. At a subsequent period he received the thanks of the Virginia House for his report on the results of his examination of the valley of the Ohio. And the war had no sooner closed than we find him, in 1784, presiding at a commission sitting at Annapolis, on behalf of Maryland and Virginia, to consider the improvement of the navigation of the Potomac, which improvement ultimately, in after years, became a canal to Pittsburg. General Washington, as an engineer, always took an active interest in works of internal improvement. When the Dismal Swamp canal, connecting the Chesapeake, at Norfolk, Va., with Edenton, Albemarle Sound, North Carolina, a distance of 28 miles, through the vast Dismal Swamp, was projected and executed at the expense of individuals with some government aid, he took some of the stock. One certificate of this stock, originally issued to him for £300, or $1,000, was sold in 1825, at auction, in Alexandria, for $12,100, to Judge Washington. Pennsylvania, nearly at the same time, appointed commissioners to explore routes for connecting the Delaware with the lakes. They reported in favor of the Juniata, partly by canal and partly by river. The result was a charter of the Schuylkill and Susquehanna Company, in 1789, and the Delaware and Schuylkill in the following year, with $400,000 capital. In New York the active mind of Gouverneur Morris had already projected the Erie canal. In Massachusetts, the Middlesex canal, 30 miles, was authorized in 1789, and completed in 1804. In South Carolina the Santee canal was finished in 1802. These, with many other events, show the activity of the public mind at the date of the birth of the Union, in relation to means of transportation. It will be remembered, however, that the people were then few in number. They were heavily in debt. Their productions were small and trade limited. There was no surplus capital to carry out those magnificent ideas, which were in advance of the times. The natural water-courses of the country ran through the finest farms and delivered most of the produce upon noble bays, which were well provided with ships to transport it abroad for sale. This natural traffic absorbed all the commercial capital of the country, but it was so profitable that in the course of a few years it supplied accumulations for other objects, and it was left for a few years later to witness the prosecution of great enterprises. The roads of the country were in a terrible state, however, and since the new constitution had empowered Congress to establish post-offices and post-roads for the conveyance of the mails, it became its duty to look to the roads, and this was the first practical bond of union between the states. A systematic connection of every town in the whole thirteen states, by state routes under one organization, completed the means of communication and established passenger routes. The statistics of the post-office afford a very good indication of the progress of that kind of transportation :—

MAIL SERVICE.

| | No. of post offices. | Miles post roads. | By stages. Miles. | Sulkies and horses. Miles. | Steam. Miles. | Rail. Miles. | Annual. Miles. |
|---|---|---|---|---|---|---|---|
| 1791..... | 89 | 1,905 | 89,650 | 756,818 | .. | .. | 846.468 |
| 1811..... | 2,403 | 37,031 | 2,534,102 | 3,058,960 | .. | .. | 5,592,652 |
| 1833..... | 8,450 | 115,176 | 17,693,839 | 8,531,909 | 628,737 | .. | 26,854,485 |
| 1859..... | 27,977 | 260,052 | 23,448,398 | 27,021,658 | 4,569,962 | 27,268,384 | 86,308,402 |
| 1868 | 26,481 | 216,928 | 45,540,587 | | 3,797,560 | 34,886,178 | 84,224,325 |
| 1880 | 42,989 | 343,888 | 76,070,995 | | 5,668,538 | 96,497,463 | 178,236,796 |

This table gives the transportation of the mail in the first year of its operation; in 1811, when steamboats began to run; in 1833, when railroads began to claim a share; and in the past year, when all these means have been more fully developed in all sections of the country. There are thus three distinct periods of transportation: 1790 to 1810 were 20 years of common roads and sail vessels; from 1810 to 1830 were 20 years of canals and steamboat progress; and since 1830 there have been 50 years of railroad progress, which has produced immense results, throwing an entire net-work over the surface of the country between the Atlantic and the Mississippi, and superseding other means of transportation. It is to be observed that in the first year of the operations of the post-office department, there were but 1,905 miles of post-roads, and that on these, nine-tenths of the service was on horseback the stage service being very small; but as the roads were improved up to 1811, the stage service came nearly to equal the horse service. From that date steam began to take the mails that ran on or near water-courses, and subsequently to 1830 the railroads began to compete with the stages on land; since that time the stage service has increased but six millions, while in the previous 20 years it had increased over fifteen millions of miles. The extension of post routes has been in 90 years, it appears, nearly 342,000 miles in the whole country, and the federal government has taken an active part in the extension of roads. The most important work of this kind undertaken was the Cumberland or national route across Ohio, Indiana, and Illinois to St. Louis. For this purpose, large annual appropriations were made by Congress. Other roads in many directions were projected, particularly from Washington to New Orleans; and in the frontier states, numerous roads were constructed by the troops under the direction of the war department.

It was thus that the federal government imitated imperial Rome, which in the days of its power clearly understood that that power was to be maintained only by the rapid march of its legions. From the "eternal city," noble causeways ran to the remotest corners of the then known world. These were military routes simply, and intelligence was conveyed upon them from station to station with great rapidity. On the fall of the empire, those noble works, instead of being preserved were demolished by small states, as a means of preventing invasion. Nevertheless, those Roman roads remained the best roads in England down to the present century. What is called Ermine street connected London with Carlisle, in Cumberland. Another is known as Watling street. Apart from those old works, the roads of England were no better than those of this country up to the present century. In this respect there is great difference between the works of the Romans and those of the United States. Those old Roman roads had no competitors. During 1,400 years they continued the best means of conveyance. The United States roads, on the other hand, were hardly done before the inventive spirit of the age set up a successful rival in the giant railway, which has become *the* trunk road. The French government, under the empire, saw the necessity of roads, and began a system for Europe. The noble way over the Simplon was the first of these. With the fall of the empire that system became confined to France, but has since been vigorously pushed—$20,000,000 per annum was expended for many years in their construction.

There were in 1815, 3,000 leagues of "royal" roads, and these had increased to 10,000 in 1850. 2,000 leagues of departmental, or county roads had, in the same time, increased to 12,100, and town roads were extended by 15,000 leagues. These extended means of communication have imparted to French prosperity much of its strength.

In the United States the impulse given to road building by the federal government was taken up by the several states, if not directly at the public expense, yet by laws which compel inhabitants to work on the local roads. These regulations are different in different states. The essential features of all the laws are nearly the same as in the state of New York, where the directing power is in "commissioners of highways," who are chosen in each town. Under these overseers are also chosen. The commissioners direct as to the grade of the road, general shape, drainage, etc. The overseers summon the persons who are to work, see that they do actually work, collect fines and commutation money. Every person owning land, and every male over twenty-one years, is assessed to work. The whole number of days' work shall be at least three times the number of inhabitants in each town. Under this system the roads are never very good. The commissioners work gratuitously, and skill, labor, and time are never to be had for that price. The overseers, being changed every year, are never experienced in the undertaking. The men they summon go to it as a half holiday, and the work the overseer sets them at is pretty sure to be that which most benefits his own place. The money subscribed is not expended in the best manner. These are all circumstances which do not favor the construction of such roads as will greatly reduce the cost of transportation. In the laying out of the road in this way, a passable track is the most aimed at.

To admit vehicles, the track must be cleared of wood by the ax-men, swamps must be overlaid with materials, rivers bridged, and the route laid around hills in order to avoid the difficulties of ascent. These are the main points to make a road practicable. It is very soon discovered that transportation on a bad road is much more expensive than on a good, and efforts are accordingly made by the most enterprising to improve the bad roads. The first step is to make the roads in such a manner as to accommodate the greatest number of people, and at the same time allow the largest loads to be drawn by horses. The better the road the larger will be the load that a team, or two horses, can draw at a given speed, and of course, the cheaper the transportation. It is to be understood, however, that the road must be equally good for the whole distance that a load is to be drawn, since if there is a space where great difficulties are to be encountered, the load must be gauged to meet that difficulty, no matter how good may be the remainder of the road. If a highroad leading through one township is not kept up, it neutralizes the public spirit of those adjoining; hence the necessity of a general system to insure continuous cheap transportation. To effect this, science has devoted its attention, but with little effect in the manner that country roads are made and kept in repair. The requisites of a road are: 1st, straightness, because straight lines are the shortest; 2d, it should be as level as possible, because every ascent causes a loss of power. Thus, if a horse draws on an ordinary level road two tons, and comes to an ascent of one foot in every twenty, he cannot ascend, because, in addition to the draught, he must lift up 200 pounds, or one-twentieth of the whole weight through the whole height. To make the road level, and save this labor and expense, the road must wind round the hill. There is little lost by this, because generally it is no further round than over. To prove this, cut an egg in half longitudinally, and set it upon the table; the line which goes round the base is the same as that which goes over the top. The half of an apple or any similar body will give the same result. Even if it were longer, it is better to go round, since the horse can do the last and not the other. The road should never be less than a rod wide, to allow two vehicles to pass. The surface of the road must be as smooth and hard as possible, in order to overcome as much as possible the resistance offered by sinking in, which is very serious, because the depression creates little hills before the wheels. Thus, if a wheel four feet in diameter sinks in one inch, to overcome the resistance thus offered one-seventh of the load would require to be lifted up over it. The harder the road, the less the resistance from this source. The greater the number of stones, hard substances, and inequalities there are to be encountered, the greater the resistance from collision. The resistance of *friction* is proportional to the roughness of the road, and the extremes of this may be illustrated by a carriage wheel on gravel and a rail wheel. The loss of power on a road, or in other words, the cost of transportation, is increased in proportion to the increase of these resistances, and inversely as they are diminished. To overcome them many improvements have been gradually adopted, such as earth, gravel, broken stone, stone pavements, wood, and railroads.

In marshy forests charcoal roads are made. Timber from 6 to 18 inches thick is cut, 24 feet long, and piled up lengthwise in the centre of the road in such a manner that the pile will be about 12 feet high. This is covered with earth, taken from ditches on either side. When the wood is charred, the coal is raked down to the widthof 10 feet, with a depth of two feet in the centre and one at the side. Such a road becomes very compact, and free from dust. Such a one in Michigan cost $660 per mile.

In the older states mostly plank roads were at one time favorites, and many hundreds of miles were constructed at a cost of $1,250 per mile. This plan has been generally abandoned. The roads not kept up are a nuisance, and many have been complained of, and removed as such.

Gravel roads have sometimes been made with the gravel from the shores of rivers, but the resistance offered by these roads is considerable.

The modes of road making here alluded to, are those which are prevalent mostly in the country districts, and where the work is performed as a tax. These answer for cross roads; but the great thoroughfares were taken in hand either by the state or by authorized companies.

Turnpike companies were chartered by most of the states, with the intention that they should construct roads having all the requisites of the best routes, and they were authorized to make a charge to those who use them. These, like most corporations, were subject to abuse; and the people were compelled to pay tolls when they had gained nothing in the way of easier transportation. New England, New York, Pennsylvania, and other states, authorized a number of companies which answered a purpose before railroads. The New York turnpike laws enact that vehicles having tires six inches wide shall pay half tolls, those with nine inches, one quarter, and those 12 inches, none at all. These enactments were designed to encourage the use of broad tires, as being less destructive to roads, but where the road is well made, as on the Macadam plan, the breadth of the tire has no effect; on the other hand, the horses' feet do the most damage. It has been calculated that a set of tires will, in average weather, on a macadamized road, run 2,700 miles, but that a set of shoes will bear only 200 miles travel.

The Macadam road, invented by a Scotch gentleman of that name, was introduced in 1820. The principle is simply that stones broken into angular fragments not over a certain size, say that of a pigeon's egg, will, under the pressure of wheels, combine into a compact mass, excluding all water, and, therefore, not subject to the action of frost, and be as solid as the original stone. These have proved to be the best roads, answering most of the conditions, and, therefore, allowing of transportation at the smallest cost. Good, well-made pavements, as used in cities, are better, since they give little resistance, and afford a foothold to the horses. In order to understand the difference in value of these roads, it may be remarked that a machine has been invented called a dynamometer. It resembles a spring balance; one end is connected with the carriage, and the other with the horses, and the power they exert is shown by the index. By such an instrument it was determined that, on a gravel and earth road, the resistance to draught of one ton was 147 lbs.; on a Macadam road, 65 lbs.; on a good pavement, 33 lbs.; and on a rail track, 8 lbs. Whence it appears that a horse can draw three times as much on a Macadam road as on an earth road; on a pavement, four and a half times as much; on a railway, eighteen times as much.

These figures indicate the gradual advance made in the power of transportation, since the roads, under the action of the state and federal government, and of the enterprising towns and cities, gradually improved from mere wagon ways to well-constructed roads in those sections where land carriage was most used. While individuals, companies, and states thus contributed to the improvement of roads, the federal government entered the field with greater vigor.

There were two motives for the construction of roads and internal improvements by the federal government. The first was to facilitate the mails; and the second was to facilitate communication. It was obvious that the new and infant states had little means to expend in the construction of roads that were to be more or less for the general benefit. The government, therefore, in organizing new states upon the national territory, made provision for the construction of roads out of the proceeds of the public lands sold within each state. The government everywhere constructed numerous roads, and after the war of 1812, when its finances began to be easy, it employed the French General Bernard and a corps of engineers in the construction of fortifications and roads. Among these engineers was Capt. Poussin. This gentleman went back to France, carrying with him the republican ideas here collected. He there propagated them with such effect that he was, in 1848, when the Revolution chased the last Bourbon from the throne, attached to the Paris *National*, the republican newspaper, and became, in consequence, ambassador of the provisional government to the United States in 1849. Thus, after the lapse of a quarter of a century, returning to the scene of his early labors.

When the state of Ohio was admitted into the Union, there were very few roads there, and the federal government was the chief proprietor of the land. It was agreed, therefore, that two per cent. of the proceeds of the land sold should be applied to the making of a road leading to the state. The same condition was made when Indiana, Illinois, Missouri, Mississippi, and Alabama were admitted, and the road was commenced. A turnpike road from Baltimore, 170 miles to Wheeling, was laid out, and a similar road from Washington, 150 miles to Cumberland was constructed. From that point the Cumberland road runs 135 miles to the east bank of the Ohio; of this distance, 85 miles are in Pennsylvania, 35 in Maryland, and 15 in Virginia. This was extended west 80 miles to Zanesville, and so through the states of Ohio, Indiana, and Illinois, to St. Louis. The road has cost the government over $3,500,000. Its effect upon transportation was very great. Before its construction it required, to go from Baltimore to Wheeling, 8 days. This was reduced to 3 days. The figures were the same for the length of travel from Washington to Wheeling. Its influence upon the country through which it ran was great. Villages multiplied in its neighborhood, and the value of property was much enhanced. The city of Wheeling was particularly influenced by it. In the year 1828 it forwarded to Baltimore over that road 3,500,000 lbs. or 1,750 tons of produce, by over 1,000 wagons. Anticipations were then indulged that a small reduction in the cost of transport would bring 100,000 tons of Ohio produce over the road to Baltimore. They did not then foresee that the reduction in cost would be brought about only by rails to Baltimore.

The Cumberland road by no means monopolized the attention of Congress, but roads were constructed in most of the states under the war department, and in the new states the army was employed in making them. Some 800 miles were thus made in Arkansas. We may allude to a few of these roads, as that to Mars Hill, Maine; Detroit to Fort Gratiot, Michigan; do. to Saginaw bay; do. to Chicago; Laplaisance bay to the Chicago road; Fort Howard and Fort Crawford; road to Chattahoochee; canal surveys in Florida; road to Apalachicola; Pensacola bay to Pittsburg, Miss.; road from Jackson to Fulton, Mississippi; Memphis to Little Rock; Green bay to Winnebago. These few names of roads spreading from Maine to Arkansas and Florida will give an idea of the extended works of the government, which also embraced removing obstructions of rivers and improving river navigation. A grand system of internal improvements was thus developed, until its growing magnitude made it a political issue, and the whole system came to an end under the Maysville road veto of General Jackson. The principle was adopted by one party, that the federal government had no power to construct any but strictly national works, or not any that were entirely within a single state. The system thus came to a violent end, after an expenditure of some $30,000,000, but not until railroads had begun already to supersede canals and roads. The federal government had thus lent a powerful hand to the extension of highways. The great thoroughfares that it had laid open had facilitated migration and settlement, and wherever these had taken place, local roads multiplied, until we find that in the year 1880 there were 343,888 miles of post-road in the Union.

The mails of the government were given out by contract to the highest bidder for four years' service. The whole mail service was divided into sections, north, east, west, and south, each being let for four years, but every year one of those fell due. The contractors agreed to deliver the mails on certain routes in a given time, for a certain amount of money. The mail money was generally depended upon for the expenses of running the vehicles, and such passengers as could be carried by the same conveyance afforded a profit. Thus the system for the circulation of letters and newspapers became the machinery for the circulation of the people. These accommodations were, however, far from being luxurious at a distance from the great cities. In these, indeed, the staging was conducted in a style approaching the splendid. The eastern stages running into Boston, and penetrating into every part of New England, were celebrated for their quality and style, as were those of New York, Philadelphia, and Baltimore, and most other large cities that were the centres of traffic, as well as post service. The different "lines" ran such opposition, as reduced the fare and promoted speed. The dandy "turn-out" being ready at the hour, well dressed, polite, smart drivers received the "ribbons" with gloved hands, and the "team" went through with a skill that could get the best time out of the nature of the road. As the traveller receded from the great centres, he found the "teams" worse, and the roads to match. The mails ran fewer times in the week, the vehicle dwindled from the easy coach to the covered spring wagon, to the open wagon without springs, ultimately to the horse, and finally perhaps to a man's back, and the traveller's accommodation diminished in proportion.

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## CHAPTER II.

### COASTERS—STEAMBOATS—CANALS.

In the neighborhood of the water-courses the traveller was better accommodated by the coasting vessels. The early settlements of the country had been, as a matter of course, upon the coast and on the numerous streams with which the country is supplied. The roads had extended back, more or less, into the country from these settlements, where the freights accumulated at the landings, whence they were carried by water for interchange with other towns, or, as the country grew, to be exported abroad. The wagon charge for freight was always so high as to absorb the value of the produce at moderate distances, and travelling was mostly upon horses, unless water conveyances could be availed of. This was the common mode for long journeys on all the rivers. The following advertisement, from a New York paper early in the present century, gives an idea of the style of travelling in the youth of men now not old.

"SLOOP EXPERIMENT—FOR PASSENGERS ONLY.—Elias Bunker informs his friends and the public, that he has commenced running a sloop of about 110 tons burthen, between the cities of Hudson and New York, for the purpose of *carrying passengers only.* The owners of this vessel, being desirous to render the passage as short, convenient, and agreeable as possible, have not only taken care to furnish her with the best Beds, Bedding, Liquors, Provisions, &c., but they have been at very great expense and trouble in procuring materials, and building her on the best construction for sailing, and for the accommodation of *ladies and gentlemen travelling on business* or *for pleasure.*

"Merchants and others residing in the northern, eastern, or western counties, will find a *great convenience* in being able to calculate (at home) the precise time they can sail from Hudson and New York, *without being under the necessity of taking their beds and bedding*, and those in New York may so calculate their business as to be certain of comfortable accommodations up the river."

This was evidently no common luxury that Capt. Bunker proffered to an admiring public. They were no longer required to "take up their beds and walk." Ladies and gentlemen travelling for pleasure could now be supplied with bedding, as well as other luxuries, on board a hundred ton sloop, and depend upon the time of her *leaving.* The wary Elias did not commit himself to the time of her arrival, however. Long experience had made him cautious on that point. However, to be certain of leaving was something, since the taking of a passage had been only a preliminary step to a voyage. The completing of the freight, the waiting for a wind, and the notification by means of a black man to be on board at an appointed hour, were now to be dispensed with. This was a great blessing, a good way in advance of the navigation 150 years previous, when permission was granted to a sloop to go from New Amsterdam (New York) to Fort Orange (Albany), provided she did not carry more than six passengers. This was the mode of reaching most of the large cities. From any point of the eastern coast the best mode of reaching Boston was by the lumber or other coasters. In these the passengers, male and female, were stowed away in a few berths in the cabin, or *sprawled* around upon the uncarpeted floor. Sometimes these vessels, when the freight earnings were eked out by a fair number of passengers, as from Bangor, Portland, or other cities, were raised to the dignity of a "packet," when a few extra berths were decorated with a red bombazette frill of rather a scanty style. In the rainy seasons, spring and fall, these were almost the only modes of travelling. It may be suppossd that passengers were not very abundant. The vessels, however, improved in size and accommodation, and the number of passengers even in the early railroad days conveyed by them was, perhaps, as large as ever. The speed of these vessels was not great, and the uncertainty of arrival such as now would by no means suit ideas of business. In those seasons of the year when the roads were generally good, the stages would make four miles per hour and arrive in fair time. Such arrangements did not permit frequent visits for the purchase of goods, and most business was done fall and spring, when the goods followed the water-courses as far as possible, and then paid from 15 to 30 cents per ton per mile, according to the difficulties of the route. Even the mail charge was from $6\frac{1}{4}$ to 25 cents per single letter, or a letter on one piece of paper, being $18\frac{3}{4}$ cents for any distance between 150 and 400 miles—envelopes, of course, were not used. Those charges were continued down to 1845, when the reduction took place.

The tonnage employed in the coasting trade had increased from 68,607 in 1789, to 420,362 in 1812. Inasmuch as but little change had taken place in the speed and build of the vessels, the increase indicates the progress of business. In 1807 the enterprising sloop owners who, like Captain Bunker, had conceived the idea of furnished berths for the accommodation of the public, were struck aghast at the success of Fulton's "Clermont"—named after the country seat of Chancellor Livingston—steaming up the river at the rate of four miles an hour under all circumstances. The conservative interests were loud in demonstrating the utter ruin that was to overtake river craft, the occupation of boatmen, and, consequently, the navy, "the country's right arm of defence," by means of this great innovator. Nevertheless, the spark of genius had kindled the flame of invention, and the public were becoming absorbed in it. Each new steamer exceeded the previous ones in build and style, and the machinery underwent as rapid improvement. As usual, however, the public were slow to be convinced. It was admitted, when it could no longer be denied, that steam would answer for the river, but it was held to be idle to attempt the Sound navigation in those new-fangled concerns. This problem was decided in the Fulton by Capt. Bunker, possibly our enterprising friend of the sloop. The "Hell-gate" passage was, in those days, an object of terror. An English frigate had been lost there in the old war, and there were not a few who still held the idea that "the devil only could beat those English who had beat the Dutch." The East River rushing up the Sound at particular times of tide poured a tremendous flood between Ward's and Long Islands. The passage narrowed to a few yards, and the tide rushed past the "hog's back" and the "gridiron," turned at right angles, and formed a foaming whirlpool around the "pot-rock," which, even with the surface of the water, was fatal to any vessel that touched it. Through that "gate of Hell" the steamer was to pass, and the operation was described by a passenger as follows:—

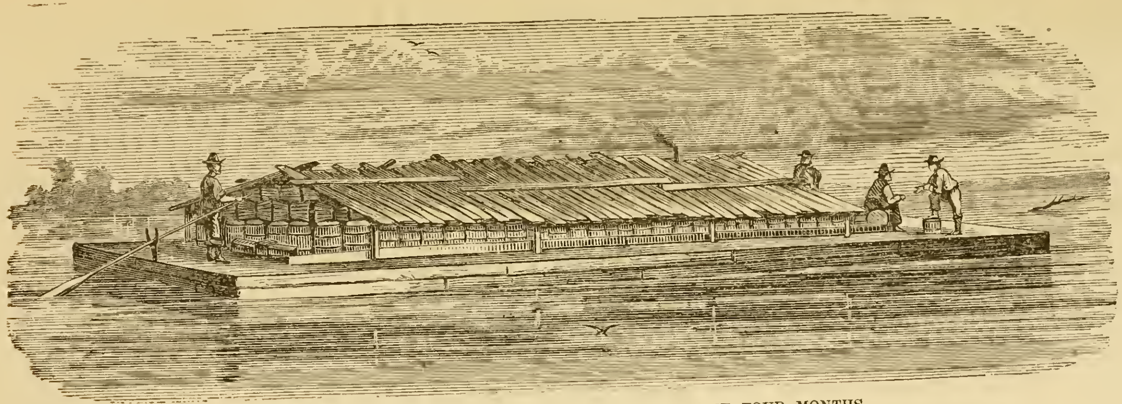
"I remember the long-agitated question, whether steamboats could be made capable of sea navigation, or so constructed as to traverse our sounds, bays, and coasts in safety. This question was put to rest by the enterprise and skill of Capt. Bunker. In the Fulton, constructed, I am told, with a view to crossing the Atlantic, he undertook the navigation of Long Island Sound, an arm of the sea in which the most severe tempests are often encountered. During a season of no extraordinary moderation, including the two equinoctial gales, Capt. B. lost but a single trip. Another doubt remained to be removed. It was supposed impossible to pass the celebrated passage of Hell-gate against the tide, at the strength of the current. This was reserved for Capt. Bunker to remove, and I happened to be on board at the time of the novel and interesting experiment, returning southward from New Hampshire. A number of respectable passengers witnessed the performance. It was in the boat Connecticut, built with all the strength to be obtained and careful workmanship. The machinist (McQueen) was accompanying his engine to prove its powers, with careful and ingenious assistants, and some of the owners were on board also. The first attempt to pass the point of greatest pressure of the contracted stream was unsuccessful, and the boat was compelled to retreat into an eddy and increase her steam. With renovated power the effort was repeated, every man fixed immovable at his post, the passengers properly stationed in different parts of the boat, the engineers employing their utmost diligence to force the passage. They were again defeated by the supposed resistless stream, and again retreated, racked, strained, and shivering, from the contest. After a short pause and fresh preparation, it was resolved by the parties concerned to make a third endeavor, and test the strength of the machinery by the greatest trial it could ever be expected to bear. After a severe struggle, in which a weaker vessel would have been disjointed and torn to pieces, the headstrong current yielded to the giant power of steam, and the triumph of art over nature was effected. A few moments of greater breathless anxiety I scarcely ever witnessed. Mechanical science achieved a victory over elementary force, and overcame an obstacle heretofore deemed in this manner altogether insurmountable. The courage and perseverance of Capt. B. were so conspicuous on this occasion, that I can never forget the impression made on all present. We have since found it as easy to traverse our sea-board, navigate the Mississippi, and cross the Atlantic, as it was to find America after Columbus had broken the egg."

To those who now so frequently make that dire passage without knowing it, this animated description must afford surprise as well as amusement. It is suggestive, not so much of the temerity of the "bold navigators" of that day, as of the feeble nature of the boats then built. The passage, to be sure, has now been deprived of most of its "horrors" by the removal of the pot-rock, which has been broken by gunpowder blasts to a depth which leaves it no longer dangerous. The noble steamers of the present day pass through at all times of tide, without apparently feeling the current, instead of butting at it three times "strained and shivering." The steamboat, after performing this feat, passed up the Connecticut river for the first time to Middletown. The North River boats continued to improve, and the time of the Clermont—36 hours to Albany—was, in 1820, reduced by the Paragon to 20 hours. In 1823, however, the time from New York to Providence, 200 miles, was 20 hours, and the stage to Boston completed the route, 40 miles, in 6 hours more, making 26 hours. At that date steamers were multiplying on all the Atlantic rivers and bays, on the western rivers and the lakes. In 1819 the first steamer crossed the Atlantic from Savannah, Ga., to England. In 1825 the Chief Justice Marshall reduced the time to Albany to 14 h. 30 m. The progress in speed may be seen by the following:—

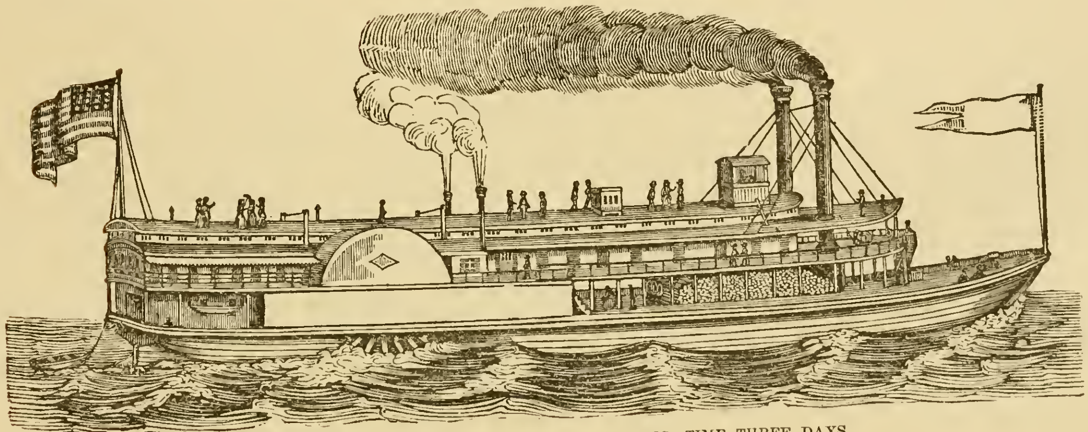
| | |
|---|---|
| 1811, Clermont's time to Albany, 4 ms. per h., | 36 hs. |
| 1820, Paragon, " " | 20 |
| 1825, Chief Justice Marshall, " | 14.30 |
| 1840, Knickerbocker, " | 9 33 |
| 1860, average time 18 miles per hour, | 8 |
| 1870, " " 21 " " " | 7 |

With the opening of the Erie canal in 1825, the quantity of goods going and coming much increased the demand for transportation, and barges in tow of steamers began a new era in that business. That goods could be carried west on the canal, and so by continuous water-courses on the lakes and their affluents, induced more passengers by the same route. In 1841 the improved method of propelling by screw was introduced by the patent of Capt. Ericsson. The iron screw steamer R. F. Stockton, of 72 tons, came from Liverpool under the command of Capt. Crane, and became a tug on the Raritan canal. Those steamers now gradually gained ground in public favor. The speed was long not so great as that of the paddle wheels. This has been gradually overcome by improved models and forms of screw, until in the month of October, 1860, two propellers of 100 feet length were launched for the North River trade, and made time 18 miles per hour, being the fastest boats for their length afloat. This class of vessels are now exclusively used in the European trade.

The settlers who had crossed the mountains in the early times of the government had located mostly on the great streams, within easy reach of the means of conveying the surplus to points of sale. They were not provided with vessels of a very expensive construction; and flat boats were the chief means of descending the streams. These vessels, designed only to go down stream, were composed of such material as, after having served the purpose of transporting produce, could be broken up at the place of destination, and sold as lumber. These were improved into keel boats, for the purpose of ascending the streams, and in either case were propelled by long poles in the hands of the boatmen. These, standing on the gunwale at the extreme bow of the boat, thrust the pole into the mud, and setting the shoulder against the top, pushed the boat forward with the feet in walking toward the stern, which reached, they drew up the pole, walked back, and repeated the movement. In this laborious mode of travel, all the merchandise sent from the east, *via* New Orleans, reached its destination. It required four months to travel thus from New Orleans to St. Louis—a distance of 1,500 miles, and the cost of the goods, it may well be supposed, was enhanced by the process; while, on the other hand, the produce sent down realized but little. Thus, between the cheapness of the produce and the dearness of merchandise received in exchange, the settler realized but little for his labor. It is easy to conceive how great a blessing was steam on those waters, to enable the weary men to stem the ceaseless, downward flow of the mighty currents. In 1811 that blessing made its appearance at Pittsburg in the shape of a steamboat, built by Fulton, and which had a considerable success. The general progress was, however, slow, for the reason, among others, that, as in all such cases, there was a large capital invested in river craft, which would depreciate in value in face of the new power, and there was not much capital to embark all at once in steam. It was also the case that Chancellor Livingston, the partner of Fulton, claimed a monopoly of the lower Mississippi trade, and put a restraint for some years upon steam in that region. So great a power could not, however, but force its way. With the construction of the Enterprise, in 1815, St. Louis was reached in 25 days from New Orleans, and public enthusiasm was aroused. There were, however, up to 1817, still but twelve boats upon the western waters, of an aggregate tonnage of 2,335 tons. The time to Pittsburg was 54 days, of which 36 days was running time. These passages caused much excitement, and a bold merchant predicted that the rate of freight between New Orleans and St. Louis would fall to $3.50 per 100 lbs., but he was regarded as visionary, or what they would now call in Wall-street language a "bear" in freights. His sanguine nature would probably have been surprised could the veil of time have been so lifted as to permit him to see 60 years ahead—the boats of the present day making money at 12 cts. per 100 lbs., and carrying it in three days, instead of 25. The Monongahela and Ohio Steamboat Company claimed patronage because their new crack boats could go nine miles an hour! But they were in advance of the times; that speed was thought to be dangerous, even if possible. Those people are now, however, not quite satisfied unless the speed is equal to 25 miles in still water. The war had given a new impulse to settlements west; the more so that steam now so much facilitated travel, and freights multiplied in proportion. Thus reciprocally the improved means of travel induced more locomotion, and increased traffic more demand for vessels. The multiplying boats and more rapid passages still found a sufficiency of business, and even the old river craft were kept in requisition for tow boats. Cincinnati began to build barges of 100 tons to go to New Orleans in tow of steamers; and the Etna made the passage down in fifteen days, reflecting great glory on the commercial enterprise of that city, and its citizens became elated. A Cincinnati writer of 1817 estimates the territory drained commercially by that city at 10,000 square miles, and remarks: "Supposing this settled by 40,000 families, and that each farm would give two tons annual surplus for exportation, there would be 80,000 tons to send to New Orleans, or freight for 800 boats of 100 tons each." The writer apologizes for the extravagance of this estimate. Commercial enterprise began to seek new routes. In 1823 three keel boats in tow passed 450 miles up the Wabash river. It was not until 1826 that the first steamer ran up the Alleghany river. In the same year the ship Illinois reached St. Louis from New York, *via* New Orleans, 3,000 miles, in twenty-nine days and a half, and the first steamer ran up the Susquehanna to Tioga. The opening of the Erie canal, in 1825, caused a great change in travel. Thus the journey from New York to Pittsburg was accomplished by canal, with only eight days staging, and thence down the river to New Orleans. In 1824 the passage up from New Orleans to New York, *via* Pittsburg, was made in 24 days, at an expense of $90. The passage from Natchez to Philadelphia, 2,000 miles, was equal to 17 days. In



FLATBOAT FROM ST. LOUIS TO NEW ORLEANS, TIME FOUR MONTHS.



STEAMBOAT FROM NEW ORLEANS TO ST. LOUIS, TIME THREE DAYS.

the same year a remarkable voyage was projected from Charleston to Green Bay. It was a sloop of six tons, with six passengers, and it reached Rochester in 15 days from Charleston. The passage of a gentleman from Detroit to Washington and back in 16 days was regarded as a miracle.

The remarkable progress of steam upon the Mississippi may be estimated most readily by a table of the passages at different periods, as follows:—

NEW ORLEANS TO ST. LOUIS—1,300 MILES.

| | | | |
|---|---|---|---|
| Prior to steam | 120 | days. | |
| 1815, Steamer Enterprise | 25 | " | |
| 1823, " average passages | 12 | " | |
| 1826, " General Brown | 9 | " | 12 hours. |
| 1828, " " | 9 | " | 4 " |
| 1860, " running time | 3 | " | |
| 1880, " " " | 2½ | " | |

The time between New Orleans and St. Louis was thus diminished under the various improvements suggested by experience in the form and mode of running steamers. A boat of 350 tons when fitted out will now cost some $50,000, and will carry 500 tons down stream, or 1,500 bales of cotton on deck. Twenty years ago the freight of cotton down from Memphis was $2 per bale, and below Natchez $1 per bale. The charge for freight up from New Orleans to Natchez was 75 cts. per 100 lbs. As the business increased, larger boats were built. Of these the Eclipse was the type. She carried 1,200 tons, but was too large to pay; and boats were then constructed of a less dimension. The Mississippi boats are large flat-bottomed boats, drawing from 15 to 50 inches of water. The speed depends upon the circumstances of the channel. That of the Memphis, recently built for the St. Louis and Memphis trade, is 18 miles in still water per hour. With light draught and great pressure, a speed equal to 24 miles in still water has been attained. The Altoona ran between Alton and St. Louis, 25 miles, in one hour and forty-five minutes, and in one hour down; average down and up, one hour and twenty-five minutes. Eighteen miles is said to be the time of the western boats. Those rivers flow with gentle currents in mostly shallow water; and there have been various changes in the fashion of the boats. The stern-wheel boat, we believe, is peculiar to those rivers. Instead of having two wheels paddling, one on each side, one wheel, 20 feet in diameter, is placed directly at the stern, athwart ships, and by its revolutions pushes the boat ahead. These boats are not remarkable for their speed, but answer in narrow and shallow streams. The regular steamers have their main decks within four or five feet of the water, and the guards overhanging the bow give them the appearance of a New York ferry-boat. The paddle wheels are generally much further aft than in the eastern steamers. The after part of the main deck is devoted to freight. Above the main deck from 10 to 18 feet is the saloon deck, which extends nearly over the whole of the main deck. The saloon is surrounded with state-rooms, which open into it, as well as on to a promenade which goes entirely round the outside of the boat. The saloon is from 150 to 250 feet long. Above this deck is a promenade deck, upon which is a long tier of state-rooms, and this, in its turn, is surmounted by another promenade deck, which has the pilot-house at its front, and which is usually 50 feet from the water. But formerly, when there was no restraint upon reckless steam pressure, or the explosive qualities of the boiler, its *height*, as well as that of the decks, was very uncertain. The "crack boats" are now built from 300 to 400 feet, with 36 to 40 feet beam, eight feet hold, and draught of water, light two feet, and loaded four feet. These steamers are now free from those reckless races which formerly so endangered life, when the safety-valve was fastened down, the furnace stuffed with tar and pitch, and the captain, rifle in hand, ready to shoot down the pilot of the opposing boat at the critical moment when the least deviation in steering would lose him the race. Those barbarous times have passed with the frontier manners of the passengers. Their sporting, drinking, gambling, fighting, have given place to business, temperance, prudence, and refinement, while wealth rolls up in the cities as a result of the speedy and cheapened transportation which the steamers have effected.

The increase of steam tonnage on those waters, has been as follows:—

| | 1842 | 1851 | 1860 | 1868 | 1880 |
|---|---|---|---|---|---|
| New Orleans | 28,153 | 34,736 | 70,072 | 52,025 | 30,113 |
| St. Louis | 14,725 | 31,834 | 55,515 | 86,135 | 141,975 |
| Cincinnati | 12,025 | 24,709 | 23,136 | 69,311 | 50,552 |
| Pittsburg | 10,107 | 16,943 | 42,474 | 53,762 | 129,026 |
| Louisville | 4,618 | 15,181 | 29,037 | 28,106 | 17,750 |
| Nashville | 3,810 | 3,578 | 5,268 | .. | 3,621 |
| Wheeling | 2,595 | 7,191 | 11,545 | 20,717 | 43,419 |
| Vicksburg | .. | 938 | .. | 2,396 | 3,426 |
| Memphis | .. | 450 | 6,143 | 13,413 | 10,780 |
| Galena and above | .. | .. | 5,849 | 25,798 | 14,748 |
| Evansville | .. | .. | .. | .. | 6,404 |
| Cairo | .. | .. | .. | .. | 7,889 |
| Omaha | .. | .. | .. | .. | 5,887 |
| Total tons | 76,033 | 135,560 | 249,039 | 351,671 | 465,600 |

It is a matter of course that while the speed of these vessels has increased in the manner indicated, their efficiency for traffic has progressed in the same ratio. In the 25 days that were formerly required to go from New Orleans to St. Louis, a steamer of the present day will make eight passages, and will carry more freight. Hence, the number of tons does not indicate the growth of the trade. If the number of tons is three times greater, the business is 30 times larger. The effect of the great reduction in the freight on goods may be illustrated by a single example. Thus, in 1815 cotton cloth was 30 cts. per yard, and 100 yards weighed 25 lbs., which would consequently be worth $30. The transportation of this at that time from New Orleans to St. Louis would cost $5, or 17 per cent. of the cost. The same quantity of cloth is now worth $9.00, and the transportation from New Orleans to St. Louis 25 cents, or 2⅘ per cent. The receipts and shipments by river, between St. Louis and New Orleans in 1879, were 1,366,-000 tons. The 18 or 20 other river ports sent and received at least twice as much more.

The war of 1812, by interrupting trade on the Atlantic, had induced a large migration to the west, when steam was opportunely developed to facilitate trade and traffic at the same time. The return of peace found a large population west of the mountains in the full tide of prosperity, and in the Atlantic states great excitement in regard to steam, with multiplying manufactures, which sought a market in the growing west. Under such circumstances the old canal projects for opening up the communication were revived in full force, the more so that the war had nearly destroyed the usual water communication.

Instead of transporting merchandise in sloops and schooners along the coast, now no longer safe from the enemy, recourse was had to wagons over roads not the best in the world. This was necessarily very slow and costly. The traffic between New York and Philadelphia, for instance, was carried on in a Conestoga wagon, drawn by four horses, and that which covered the distance of 90 miles in three days was known as "the flying machine," and the value of goods at either end of the round showed great fluctuations, enhanced by the expense. This extra expense for the whole coast alone, it was asserted, would have paid the whole cost of a system of internal navigation from Maine to Georgia. It was then that the enterprises to which the great minds of the Revolution had given birth at the peace of 1783 began to be realized, and two objects were sought, viz.: a safe inland water communication along the whole Atlantic border, to operate in case of war, and another to connect the waters of the west with the east, and the public began to regard with more favor the project of uniting the lakes to the Hudson river. Mr. Morris, who had suggested it at the close of the Revolution, wrote an able report in its favor in 1812, when the war gave new interest to it. The undertaking was formidable, and New York applied to the federal government and other states for aid, but her application was met with jeers and ridicule. The result was the determination of the state to undertake it alone, when the return of peace allowed of more facility for its execution; accordingly, on the 4th of July, 1817, the Erie canal was commenced with great ceremony, Governor De Witt Clinton turning the first earth, and it was completed October, 1825. The event was celebrated with the greatest pomp along the whole line, and in the city of New York. The canal is 363 miles long, 40 feet wide at top, 4 feet deep, and the capacity of boats, 80 tons. The original cost was $7,143,789, or $19,679 per mile. This immense work gave the long-wished-for communication between the great lakes and the tide waters of the Atlantic. In the same year, viz., October, 1817, a canal connecting the waters of Lake Champlain with the Erie canal some miles from Albany was commenced. This Erie and Lake Champlain or Northern canal is 63 miles long, and was completed at the close of 1823, at a cost of $1,257,604, or $19,862 per mile. Both of these canals were subsequently enlarged (the Erie several times), and the cost was greatly enhanced. Other canal projects, most of them under the plausible plea of being feeders of the Erie canal, were forced through the state legislature, and liberal appropriations made for their construction. Most of these were built between 1825 and 1837. None of them have proved permanently successful, and they have been a constant drain upon the income of the Erie canal. The Chenango canal and several others have been abandoned, and the land which they held sold.

The following table shows the original

cost of construction and enlargement of all the state canals, as it stood in 1867. There has been no considerable enlargement since that time, though there have been some expenses charged to construction account.

| Canals. | Cost. |
|---|---|
| Erie and Champlain | $46,018.234.19 |
| Oswego | 3.490,949 24 |
| Cayuga and Seneca | 1,520,542.59 |
| Chemung | 1,273,261.86 |
| Crooked Lake | 333,277.27 |
| Chenango | 2.782,124.19 |
| Black River | 3,224.779.55 |
| Genesee Valley | 5,827,813.72 |
| Oneida Lake | 64,837.68 |
| Baldwinsville | 23,566.14 |
| Oneida River Improvement | 146,994 02 |
| Seneca River towing path | 1,488.33 |
| Cayuga Inlet | 2,968.16 |
| Total | $64,710,836.94 |

The great success of the Erie, as we have said, roused the emulation of other states, and during the five years succeeding the opening of the Erie the air was filled with canal projects, only to name which would occupy much space. We may mention some of the most extraordinary, however: a canal from Boston to Narragansett bay; Long Island to Canada, *via* the Connecticut river; Boston to the Connecticut river; a canal over Cape Cod; Providence to Worcester; a ship canal across Central America. These projects only indicate the extraordinary activity that the Erie success had imparted to the public mind. Those which were evidently the most needed for present and future commerce, were immediately undertaken. The Chesapeake and Ohio, to connect the waters that the name designates; the Ohio canal, to connect Lake Erie with the Ohio river; the Farmington canal, in Connecticut, afterward used for a railroad site; the Chesapeake and Delaware, to connect those waters, were all ready, and broke ground July 4, 1825, three months before the Erie was finally completed. These works, with many others, which we shall take up in their order, were pushed to completion, under various difficulties, inasmuch as that they required a large amount of money, but they had an immense influence upon traffic, and called into requisition an amount of engineering skill which had never before been demanded in the country, and various success has attended the construction. The object of a canal is, of course, to float boats that contain merchandise, between two points, in order to reduce the expense of the transportation. The canal is therefore constructed with some regard to the amount of business that will be required of it. The channel must be excavated on the level soil, carried over gaps and rivers by embankments that will hold the water, and it must be fed by abundant streams.

The channel is excavated with the two sides sloping at the same angle, which varies with the nature of the soil. The base of the slope is commonly to the height as 5 to 4. The bottom of the canal is generally the breadth of two boats upon the deck, in order that they may pass. The depth of water in the canal should be at least one foot more than the draught of the boats. The tow-path is about two feet above the level of the water, and about ten feet wide. When the canal runs through a sandy soil, or one that does not easily retain water, the bottom is "puddled." This process is to mix clay well with gravel and put it on in successive layers of two or three inches thick. When a new layer is put on, the old one is roughed up to make both adhere well. When repairs are needed, they are generally done at the time the water is let out for the winter. The bed of the canal is so laid as to give a gentle current to the water. The levels are the distances between the locks, and each level, proceeding downward, has a less elevation than the preceding one. In a hilly country these locks are frequent, and in some cases are continued for a distance, like steps up and down a declivity. Thus the Erie canal, on leaving Lake Erie at Lockport, descends 60 feet to the Genesee river. To perform this, ten double locks built in masonry are required, but the canal has also one level of 63 miles without a lock. The lock is a chamber built of timber or masonry, as large as possible for the size of the canal. The boats must not exceed what can be admitted to the locks. The top of the lock is above the surface of the water, and its bottom is level with that of the next lower level. Each end of the chamber is closed by heavy swinging doors, which open in the middle against the direction of the current. The doors being a little broader than the lock, they meet in the middle at an angle, and the weight of the water presses them together. When a boat going up the canal comes to a lock, it passes between the open gates, which close behind it. The water is then let in from the upper gates, until the lock being full, the boat floats to the upper level, generally about 10 feet rise, but sometimes 18 feet. It passes out, and another boat being ready to go down takes its place, when, the upper gates being closed, the water is let off below and the boat lowers with it to the lower level. A lock full of water is thus discharged. It follows that a large supply of water must be had to replace what thus passes off, in addition to leakage and evaporation. The engineer of the Erie canal calculated the loss by leakage was 100 cubic feet per minute. For supply, reservoirs are often constructed. Canal branches, called feeders, are made to bring water from distant sources. Steam power is also used to raise water to the required level. This is the case with the Illinois and Michigan canal; the waters of Lake Michigan being pumped up to the summit level. In some cases inclined planes are substituted for locks. In these cases the boats run upon trucks, which are then, by the power of steam, dragged up the plane to the higher level. In the Morris canal, of New Jersey, these have a slope of one in 21. These are the general features of all the canals, but the influence they have upon transportation depends, of course, in some degree, upon the localities and the capacities of the work. Boats are commonly towed upon a canal by horses. A single horse can draw upon a good road a ton at a speed of 2½ or 3 miles per hour, and can draw as easily 70 tons upon a canal at the same speed. The difference in cost is immense. Instead of 24 cents a ton for one mile land carriage, the Erie canal charges 6 mills per ton per mile, or one-fortieth part of the expense. The freights charged are distinct from the state tolls. It is obvious that where the boats are of greater capacity, allowing of a larger quantity to be passed down at the same passage, the cost of transportation is much diminished. Thus the Delaware and Hudson canal had a capacity for 50 ton boats, and coal was carried 108 miles for $1. The enlargement of the canal so as to admit boats of 100 tons reduced the cost 65 cents, but some of the boats carry 148 tons at proportionate rates. When the routes of the canals of other states threatened to affect the business of the New York canal, the reduction of the cost by means of enlargement was the means resorted to to retain the trade, and the enlargement has been prosecuted at great expense. The principle of the enlargement was based upon the fact that as the canal is abundantly supplied with water, the only limit to its capacity would be the time required to pass boats at the locks. It was calculated that 26,000 boats can be locked each way in a season. The old canal boats were about 70 tons, hence the utmost capacity of the canal would be 3,640,000 tons; but by the enlargement the boats were to be of 224 tons burden, hence the tonnage would be 11,648,000 tons, if the quantity moving each way was the same, but the down freight is as four to one of the up, which reduces the capacity to 7,230,000 tons. Before the canal was built, the expense of transportation from Buffalo to New York was $100 per ton! and the time 20 days. A ton of wheat in New York was then worth about $33, hence the transportation was three times the value of the wheat, six times the value of corn, and twelve times the value of oats. As a consequence, the wheat of western New York at that time went down the Susquehanna to Baltimore as the cheapest and best market, as the lumber of the head waters of that river now goes. When the canal was opened, the freight down was about $14 per ton, more or less, according to the character of the freight. This has gradually been reduced, and in 1850, when the railroads for the first time were allowed to carry freight, it was $3 to $7 from Buffalo to New York. By the enlargement the rates have been reduced to $1.75 per ton between Albany and Buffalo. Since the permission of railroads to carry freight, however, the business of canals is more confined to those heavy freights furnished by the raw produce of the country, lumber particularly. Those coarse and bulky articles that are of low money value as compared with their weight will continue to move upon canals, but the lighter and more costly, as well as those pressed for time, will be carried exclusively by rails. These latter have some disadvantages, however, as in the case of flour, the motion of the railroad causing it to waste, an objection not urged against canal travel.

The total length of the five great lakes is 1,555 miles, and the area 98,000 square miles, and they are estimated to drain an area of 365,515 square miles. That vast tract of waters was a waste as far as transportation went until the year 1797, when the first American schooner was launched. The craft increased to some extent for the small commerce that engaged the settlers when there was no outlet either to the Atlantic or to the south. In 1816, however, a steamer was built on Lake Ontario, and in 1819 the Walk-in-the-Water, 340 tons, was launched at Buffalo. The most of the trade, however, consisted in the operations of the Indian traders, carrying westward supplies and trinkets for the trade, and returning with furs and peltries. On the opening of the Erie canal, in 1825, a new state of things presented itself. Western New York threw off its frontier aspect, and put on an air of civilization, since it became a receiver of western produce and exporter of goods. The steam tonnage multiplied to transport the growing produce of the west. In 1822 the Superior was launched, another steamer in 1824, two in 1825, and three in 1826. One of these made the first voyage upon Lake Michigan, in 1826, on a pleasure excursion. It was not until 1832 that business called them thither, and then one reached Chicago, in the employ of the government, to carry supplies for the Black Hawk war. From that time the steamer tonnage has increased as follows:—

| Custom Districts. | 1841 | 1850 | 1868 | 1880 |
|---|---|---|---|---|
| New York Lake Ports. | 6,773 | 25,990 | 56,273 | 65,176 |
| Erie, Pa. | .... | .... | .... | 18,353 |
| Cuyahoga, Ohio | 1,855 | 6,418 | | |
| Sandusky | .... | .... | 16,100 | 29,473 |
| Miami | 887 | 1,745 | | |
| Detroit, Mich. | 2,053 | 16,469 | | |
| Huron | . .. | .... | 46,264 | 70,426 |
| Superior | .... | 1,746 | | |
| Michigan, &c. | 2,813 | 5,691 | 432 | |
| Chicago | .... | 652 | 10.849 | 9,950 |
| Milwaukee | .... | .... | 10.939 | 16,981 |
| Duluth | .... | .... | .... | 155 |
| Total | 14,381 | 58,711 | 14[illegible],861 | 212,045 |

The 11 boats running in 1833, carried to and from Buffalo 61,485 passengers, and the fares with the freight amounted to $229,-212. Those were the years of the great land speculations, and crowds of passengers went west on that errand. Three trips were made a year to the upper lakes. The trips to Chicago from Buffalo occupied 25 days to go and return. In 1841 the time required for a first-class steamer was 10 days from Buffalo to Detroit and back. This was reduced in 1851 to 3 days, and 5 for propellers. In 1834 the lake commerce was controlled by an association, owning 18 boats. This association was kept up to 1841, when the number of boats had increased to 48. The opening of the Ohio canals had poured upon the lakes a large amount of produce. The 500 miles of canal then completed, opened up the grain country to the lakes. In 1835, Ohio exported by the lakes 543,815 bushels of wheat; in 1840, 3,800,000 bushels; and in 1850, 12,193,202 bushels, which paid $500,000 freight and charges. In 1860, the wheat received from lake ports was:—

| | | |
|---|---|---|
| From Ohio, | 2.856.216 | bushels. |
| " Indiana, | 3.219,225 | " |
| " Michigan, | 2,117,970 | " |
| " Illinois, | 12,195,195 | " |
| " Wisconsin, | 5,447,766 | " |
| " New York, | 130,667 | " |
| Total, | 25,967,039 | " |

In 1880, the amount of wheat *exported* from these lake ports, beside that retained for home consumption, was 156,977,669 bushels.

The successive opening of the Ohio canals in 1833, the Illinois canal in 1848, and the Indiana canal in 1851, all added constantly to the amount of produce to be transported, and since the last-mentioned date the rail roads have opened new regions of country, and increased the lake trade. It is to be borne in mind that the size of the vessels, their great speed when under way, and the greater dispatch in loading and unloading by steam, not only for motion, but for labor at the dock, enable the same quantity of tonnage to do ten times the business that it formerly could do. In the lake trade the sailing vessels and the large canal boats still exceed in tonnage the steamers, there being 352,092 tons of the former to 253,011 of the latter. The side or paddle wheel steamers, have, since 1855, been giving place to the propellers, and the latter are now generally preferred. In 1843 the first lake propeller, the Hercules, was launched at Cleveland, 275 tons, the screw of Ericsson's patent. In 1851 the propellers had increased to 52, with a tonnage amounting to 15,729. In 1880 there were 910, tonnage 205,045. These boats had, at first, far less speed than the paddles, but they have gained in public opinion, not only upon the lakes, but in the Atlantic bays and rivers, until recent improvements have made them equal to the paddle-wheels in speed. These vessels have already monopolized the European, as well as the internal trade.

Previous to the opening of the Erie canal, in 1825, the commerce of the lakes was necessarily local, since there were no markets east or west. The produce raised in the country bordering the lakes descended the streams that ran into them, and found interchange with other lake ports. The opening of the canal immediately gave an eastern current to produce of all descriptions, and much had accumulated in anticipation of the event, and goods returned in great quantities. In the month of May, 1825, 837 boats, carrying 4,122 tons of goods, left Albany for Buffalo, paying $22,000 tolls.

The lumber from western New York and the lake borders being now marketable where before it was valueless, a motive for clearing land was imparted, and the new canal received on its bosom from all sections of the lake shore the lumber brought by multiplying vessels. The lumber that found tide water before had been that which in southern New York and in Pennsylvania skirted the natural water-courses, and being cut and hauled, was rafted down to Philadelphia and Baltimore. The New England streams delivered the lumber in the same manner. The opening of the canal brought into competition the vast and hitherto untouched resources of the west, and the same remark applies to all farm produce. The farmers of New England were undersold at their own doors, by produce from western New York. The potatoes that had been quick of sale at 75 cents, were supplanted by the best "chenangos" at 37½ cents, and the competition was felt in corn, flour, and most articles. The effect of this was to turn the attention of that hard-working and thrifty race of men, the farmers of New England, to the western country, where the soil was so much more profitable. At that date commenced the interchange of inhabitants, which has drawn off so many New England farmers, replacing them with manufacturers from abroad. In order to show the extent of this operation, we take from the census of 1870 the figures showing the nativities of the whole people of the United States. Thus there were in the whole Union 11,614,101 persons who were born in the New England and Middle States. Of these, 8,800,-367 lived in the states where they were born. The remainder, 2,813,734 were living mostly west, but in their place there were living in the New England and Middle States, 3,628,182 persons who were born in foreign countries. These latter worked in the mills and manufactories, while as many northern persons who had migrated west were agriculturists attracted thither by the fertile lands made available by the means of transportation. The lakes were now connected with tide water, but the whole system of western rivers with a southern course had no northern connection. The state of Ohio determined to make the connection, by means of a canal from Portsmouth, on the Ohio, to Cleveland, on Lake Erie. On the 4th July, 1825, the first spade was put into the ground, and in 1833 the first boat passed through from lake to river, 307 miles. The whole interior of Ohio was thus opened to either the northern or the southern market; and the state authorized turnpikes and other roads to feed the canal, on the borders of which trade grew rapidly. There are several branches of the Ohio canal; one, the Hocking, goes to Athens, and another to Columbus. The highest level of the Ohio canal is 305 feet above the lake, and 499 feet above the Ohio river. Another canal, the Miami, was also commenced in 1825 to connect Cincinnati with Lake Erie. In 1829 it had been opened to Dayton, 85 miles, but it was not completed until 1843, when it connected, 130 miles, with the Wabash canal, which joins Lake Erie at Toledo, making 215 miles from Cincinnati to Lake Erie. All the Ohio canals are as follows:—

| | Length. Miles. | Cost. |
|---|---|---|
| Ohio canal | 340 | $4,695,202 69 |
| Miami | 85 | 1,020,000 00 |
| " extension | 130 | 3,667,440 82 |
| Muskingum | 92 | 1,628,028 29 |
| Hocking | 56 | 975,481 01 |
| Wabash and Erie | 91 | 3,009,923 29 |
| Walhonding | 25 | 607,268 99 |
| Total | 819 | $15,603,345 09 |

Subsequent additions and slackwater improvements have made the whole number of miles of canal 996, and the cost over 20 million dollars. By these canals and others in Indiana, Illinois, and Kentucky, the states east of the Mississippi river have water communication with New York city. The enlargement of these canals to admit steamers of 600 tons will greatly facilitate commerce.

The state of Pennsylvania next undertook the great work of forming a connection between the Delaware and the Ohio. The project which had been formed at the close of the last century was now resumed; and in 1826 a law was passed to construct the work at the expense of the state, and, July 4th, 1826, the first earth was turned at Harrisburg, and in 1834 it was opened for use. The line consisted of a railroad, 82 miles, from Philadelphia to Columbia, cost $3,330,127; a canal from Columbia, 172 miles, to Hollidaysburg, cost $4,594,146;

a portage railroad across the mountain from Hollidaysburg to Johnstown, 36 miles, cost $1,634,357; and a canal from Johnstown to Pittsburg, 105 miles, cost $2,823,192—making 395 miles, at a cost of $12,381,822. Thus the Ohio at Pittsburg was now connected with Philadelphia, by a route much less than from Buffalo to New York. There were seven branch canals made to feed this. The aggregate length was 314 miles, and the cost $6,471,994. Every part of the state was now more or less in communication with the great outlets east and west. There were, besides, three private canals, viz.: the Schuylkill, 108 miles; the Lehigh, 85 miles; and the Union, 82 miles, which connected the great coal fields with tide water.

We have shown that Washington presided, at the close of the Revolution, at a meeting for the improvement of the Potomac. The ideas then suggested ripened into a project for a canal. The cession of a portion of Maryland and of Virginia to form the District of Columbia as a seat of government led to the national desire to connect it with the west. This was done, as we have seen, by the National or Cumberland road to Wheeling. But in 1820 the canal from Georgetown to Pittsburg was projected, Congress voting $1,000,000. Washington City issued bonds for a like sum. Georgetown and Alexandria each subscribed $250,000, Maryland $500,000, and Virginia $250,000, and 6,084 shares of $100 each were taken by individuals, making altogether $3,854,400. As the work was to run through four territories, it required a charter from Congress, Maryland, Virginia, and Pennsylvania, and July 4th (Fourth of July is a great day for canals), 1828, John Q. Adams and Charles Carroll turned the first earth. In 1834, 104 miles had been completed. The work was finally carried 191 miles to Cumberland in 1840, at an expense of some $16,000,000. It will not probably be carried further, never having answered expectations, although of late it has had business from the Cumberland coal regions.

Thus of the three great projects for connecting the eastern and western waters, only two were carried out. But, following the example of Ohio, both Indiana and Illinois determined to make a connection across their respective states, between the rivers on the south and the lakes on the north. But they were some years later than Ohio, since they were younger and weaker states. In 1836, under the spur of the speculative fever, Indiana enacted a bill authorizing a system of internal improvements. This embraced the Wabash and Erie canal, to run from Evansville on the Ohio to the Ohio state line, where it was to follow down the valley of the Maumee, taking up the Miami canal in its course, and entering the Erie Lake at Toledo. Second, the White Water canal, to connect the National or Cumberland road at Cambridge, with Lawrenceburg on the Ohio, 76 miles. Third, the White River canal, to connect Indianapolis with Evansville on the Ohio, 190 miles, and to prolong it from Indianapolis to Peru on the Wabash canal. There were also to be some Macadam roads and turnpikes. These works were to cost $10,000,000. The Wabash canal was begun in 1835, and in 1840, 90 miles were finished. The great revulsion then brought all to a stand, and some ten years elapsed before the work was completed through the aid of a loan obtained on pledge of lands granted by Congress in aid of this work.

The state of Illinois undertook a far more extensive system of public improvements. As early as 1810 a project was put forward, under the excitement of Fulton's great success, to connect New Orleans with Buffalo in 32 days by steam, by way of Chicago. The waters of the Illinois and the lakes were in high floods nearly blended. In 1823 a board of commissioners was appointed to report on the route and the cost. A grant of land was obtained from Congress in 1829 in aid. This was every alternate section of land, 10 miles on each side of the canal, in its whole length. Not until 1835 was an act passed to authorize the canal, in common with many other works, railroads or others, in a general system of internal improvements, which were to cost $12,000,000, and there had been sold of the lands granted by Congress $1,395,911.

The canal was to connect Chicago, at the foot of Lake Michigan, with the Illinois river, 102 miles. It was prosecuted with more or less vigor until the finances and credit of the state were ruined by the revulsion of 1837–9. The work then lay unfinished until in 1843, by means of a pledge of the unsold lands of the canal, a sum of $1,600,000 was borrowed, and the work completed in 1852. The sales of the land sufficed to pay off the new loan and some of the arrears.

We have thus sketched the great main canal avenues that connect important sections, and may state their original cost as follows:—

| | | | Miles. | Expenditure. | Width. Feet. | No. of Locks. |
|---|---|---|---|---|---|---|
| Erie canal | Hudson river to lakes | | 363 | $7,143,789 | 40 | 84 |
| Pennsylvania canal | Delaware and Ohio | | 395 | 12,381,822 | 40 | 200 |
| Ohio " | Ohio river and Lake Erie | | 307 | 4,695,824 | 40 | 152 |
| Miami " | " " " " | | 178 | 3,750,000 | 40 | 102 |
| Indiana " | " " " " | | 379 | 7,101,000 | 60 | 102 |
| Illinois " | Lake Michigan with Illinois river | | 102 | 8,654,337 | 60 | 2 |
| Total | | | 1,724 | $43,726,772 | | |

The financial results of the New York canals may be thus stated in the aggregate of receipts and revenues from the commencement of the works to Sept. 30, 1870:

| Receipts. | | Expenditures. | |
|---|---|---|---|
| Gross Tolls | $113,795,543.65 | Construction | $71,858,067.21 |
| Loans | 56,331,755.29 | Repairs | 33,658,150.00 |
| Other Items | 46,969,815.84 | Loans and Int. | 87,574,788.68 |
| | | Other Items | 21,262,667.01 |
| Total | $217,097,114.78 | | $214,353,672.91 |

The change of policy in the canal management has made a great change within the last six years in the canal receipts. In 1880, the net receipts from tolls were about $900,000. With the contemplated enlargement and the use of steam to propel and tug the canal boats, a new and powerful impulse will be given to the transportation of heavy and bulky goods to and from the West. By their construction a vast capital was added to the national wealth, and a great value bestowed upon land not before very marketable. While this has been done by state means, a great number of other canals have been erected, jointly by public aid and private enterprise. The most important of these was the Delaware and Raritan canal, connecting those two rivers. The work was completed in 1827, shortening the distance 16 miles between Philadelphia and New York, and packet propellers run regularly through it between the two cities. It is also the main source of supply of coal for New York. The state of Virginia early embarked in improvements, particularly in the James river, which is navigable to Richmond for vessels of 120 tons, the tide reaching there; above Richmond a series of short canals intended to connect the river with the Kanawha, where it is navigable 70 miles from its mouth on the Ohio. This project was undertaken by the James River and Kanawha Company, and was completed in the form of a canal, 147 miles, at a cost of $5,020,050. There are many other works of public utility in Virginia, under the control of a board of public works, chartered in 1816. There are a number of other canals in several states, as the Blackstone, of Massachusetts; the Ogeechee, of South Carolina, connecting Charleston with the Santee, cost $650,667, and many other improvements in a number of states. The Morris and Essex canal, of New Jersey, 101 miles, was completed in 1831. It had banking powers connected with it, and of all the public works in the country was the basis of the most stupendous stock speculation. Its liabilities were at one time near $10,000,000, and it was sold out in 1845 for a sum less than $3,000,000; its business is at present prosperous. It is one of the works that were erected to develop the great coal business of Pennsylvania. The discovery of that important mineral takes date about the year 1820, and the canals that were built to bring the coal down may be enumerated as follows:—

| | | Length. Miles. | Cost. | Width. | Locks. |
|---|---|---|---|---|---|
| Schuylkill navigation | Pennsylvania | 108 | $2,500,196 | 36 | 120 |
| Lehigh canal | " | 85 | 4,455,099 | 60 | 81 |
| Susquehanna | " | 41 | 897,160 | 40 | 12 |
| North Branch | " | 73 | 1,590,379 | 40 | 8 |
| " " upper | " | 94 | 4,500,000 | 40 | .. |
| Union | " | 82 | 5,000,000 | 36 | 90 |
| Delaware and Hudson | New York | 108 | 9,100,000 | 75 | 18 |
| Morris canal | New Jersey | 102 | 3,612,000 | 32 | 29 |
| | | | | planes, | 22 |
| Total canals | | 693 | $31,654,834 | | |

The expenditure of large sums of money along the routes of these works for their construction promoted a local demand for produce, and aided in the settlement of the country through which they ran, and from the improvement of which their future freightings were to be derived, and there is little matter of surprise that the first years of their operation should be of large promise. The cost of transporting a ton of merchandise from Buffalo to Albany, which had been $100, and the time twenty days, was at once reduced to $20, and the time to eight days. While yet they were being constructed, however, a new agent of transportation had risen, which was to overshadow their importance, and reduce them to a second rank. The rejoicing for the completion of the Erie had hardly died away, before the locomotive began to throw its shadow on the future. The "astonishing speed" of steamboats and stages was about to dwindle into an intolerable tedium. The capacities of railroads had begun to be discussed, and the discussion rapidly elicited action, which did not cease to extend itself, until the whole country has become covered with rails. When railroads began to be constructed, however, both vehicles, sailing vessels, and steamers had made considerable progress in speed, and the connections of travel had come to be made with more regard to dispatch. It is amusing to look back at some of the accounts of the wonders of the canals after the opening. Thus, in 1823 it is stated—

"Canals! A *sloop*, called the Gleaner, has arrived at New York from St. Albans, in the state of Vermont, with a cargo consisting of 1,200 bushels of wheat and other articles. She will carry sixty tons of merchandise, and does not appear to have had any difficulty in passing through the northern canal. It is supposed that she will safely navigate the Hudson, and she is designed as a *regular packet* between St. Albans and the city of New York. *Look at the map!* An uninterrupted *sloop navigation* from one place to the other!

"When the Green Mountain vessel arrived at New York, the veteran artillery were ordered out, and she was saluted from the battery."

In 1824. "Internal Improvement. It is stated in one of the New York papers that a barrel of flour can be transported from Albany to New York, a distance of 150 miles, for 12½ cents, and that one individual offers to do it for seven cents."

In 1825. "March of Intellect with Power.—It is no fairy tale, that flour, *manufactured on Lake Erie*, has been profitably sold in Newbern, *North Carolina*, for $5.50 per barrel. This flour was transported from the lake to Albany, through the Grand canal; thence down the North River to New York; and thence, by sea, to Newbern. The cost of transportation from the lakes to Newbern was less than $1.50 per barrel, while that between Raleigh and Newbern (not more than 120 miles) is generally two dollars."

In 1826. "The following, from the *Pittsburg Gazette*, shows the importance of canals. Mr. Foster has published in the *Greensburgh Gazette* a statement furnished him by a merchant of Meadville, showing the amount which the merchant paid for the transportation of his goods this fall from Philadelphia, *by way of New York*, the canal, and Erie, to the town of Meadville. The whole cost per hundred pounds was $1.20½! *We are now paying three dollars per hundred for carriage in wagons from Philadelphia to this city!*"

These extracts afford—in contrasting not only the routes, but the prices, with those before their use and those which now exist—much room for reflection. It may be remarked that the Caroline, burnt in the employ of the Canada rebels in 1839, at Schlosser, and sent over the falls of Niagara, was built in South Carolina, and had passed up the canals to her destination.

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## CHAPTER III.

### RAILROADS—LAND GRANTS—EXTENT AND COST.

The excitement in relation to canals and steamboats was yet at its zenith, when the air began to be filled with rumors of the new application of steam to land carriages and to railroads. There were many inventions and patents at home and abroad in relation to carriages propelled upon common roads by steam, but these seem never to have attained much success, although attempts to perfect them are still made with great perseverance. On the other hand, the use of railroads from small beginnings has reached a magnitude which overshadows the wildest imaginings of the most sanguine. In 1825 descriptions came across the water of the great success of the Darlington railroad, which was opened to supply London with coal, and which had passenger cars moved by steam at the rate of seven miles per hour.

The most animated controversy sprang up in relation to the possibility of such roads in England, and was shared in to some extent on this side of the Atlantic. With the national energy of character, the idea had no sooner become disseminated than it was acted upon. The construction of railroads in America is usually ascribed to the emulation excited by the success of the Liverpool and Manchester railway. This appears not to have been the case, however, since some of the most important works in this country were projected and commenced before the Liverpool and Manchester road was built. The act of Parliament for the construction of that road was passed in 1826, and the road itself was finished and opened in September, 1830, 31 miles long; but the Massachusetts Quincy road, three miles from Quincy to Neponset, was opened in 1827, and a great celebration was held in consequence. The celebrated Mauch Chunk railroad of Pennsylvania was begun in 1826, and finished in the following year. On that road the horses which draw up the empty coal wagons are sent down on the cars which descend by their own gravity. This contrivance was borrowed by the Mauch Chunk road from the Darlington road, similarly situated, in England. It is to be remarked that both the Quincy and the Mauch Chunk roads were horse roads; the locomotive was not at first introduced. In 1828, twelve miles of the Baltimore and Ohio railroad were completed, two years before the Manchester road was opened. In the same year, 1828, the South Carolina road, from Charleston to Hamburg, was surveyed, and in Massachusetts the city of Boston voted the construction of a road from that city to the Hudson at Albany. The first portion of that road, however, Boston to Worcester, 44 miles, was not opened until 1835. The second road finished in the United States was the Richmond, Va., road, thirteen miles to Chesterfield, in 1831, and in the same year that running from New Orleans, five miles to Lake Pontchartrain, was opened. Thus roads were well adopted in public opinion here before the great success of the Manchester road was known, but which gave an undoubted impulse to the fever. During the excitement in relation to "rail" roads, a writer in a Providence paper thus satirized the condition of the Connecticut roads. He claimed the invention of the cheapest "rail" roads, and proved it thus: "Only *one* English engine *alone* costs $2,000, which sum the whole of our apparatus does not much exceed, as figures will prove; for 700 good chestnut rails at $3, amounts to only $21, and it ought to be remembered that this is *all* the expense we are at, and the inference is conclusive in our favor. We place our rails fifty to the mile by the side of the road, to pry out the wheels when they get stuck, and hoist behind when wanted." The public were, however, no longer to be satisfied with this kind of "rail" road. They embarked in the new enterprise with such vigor, that in 1836 two hundred companies had been organized, and 1,003½ miles were opened in eleven states. These were highly speculative years, however, and the revulsion brought matters to a stand.

It was at once apparent to the commercial mind that if railroads would perform what was promised for them, geographical position was no longer important to a city. In other words, that railroads would bring Boston into as intimate connection with every part of the interior as New York could be. The large water communication that enabled New York by means of steamboats to concentrate trade from all quarters, could not now compete with the rails that would confer as great advantages upon Boston. Indeed, Boston had now availed herself of steam power. Up to 1828 she owned no steamers. The Benjamin Franklin, built in that year, was the first, and her steam tonnage is now but 9,998 tons. When she bought her first steamboat, however, she was laying out those railroad connections that she has since pushed so vigorously, and they have paid an enormous interest, if not directly to the builders, at least to the general interests of the city.

It is to be remarked that the national government expended, as we have seen, largely in the construction of highways, the clearing out of rivers, and the improvement of harbors. The people have by individual taxes mostly constructed the earth roads of this country. The canals have, however, with a few exceptions, been state works, built by the proceeds of state loans, with the aid of lands donated by the federal government. These lands were made marketable and valuable by the action of the canals in aid of which they were granted. The railroads of the country have been, as a whole, built on a different plan, viz., by corporations, or chartered companies of individuals. These associations have not, however, themselves subscribed the whole of the money, probably not more than half, but they have found it to their interest to borrow the money on mortgage of the works. The great object of the companies has not been so much to derive a direct profit from the investment, as to cause the construction of a highway, which should by its operation increase business, enhance the value of property, and swell the floating capital of the country by making available considerable productions of industry, which before were not marketable, since the influence of a railroad in a new district is perhaps, if not to create, at least to bring into the general stock more capital than is absorbed in its construction.

Thus in the last forty years, four thousand millions of dollars have been spent in the construction of roads, and yet capital is proportionally more abundant now than before this vast expenditure, and land has, in railroad localities, increased by a money value greater than the cost of the roads! We have seen that before the operation of canals, land transportation was, and is now remote from these works, one cent per mile per hundred. If a barrel of flour is then worth in market five dollars, a transportation of 300 miles would cost more than its whole value; but by rail it may be carried from Chicago to New York for sixty cents. Thus railroads give circulation to all the surplus capital that is created by labor within their circle. It is on this principle that may be explained the immense prosperity that has been seen to attend the enormous expenditure for railroads, particularly during the last ten years.

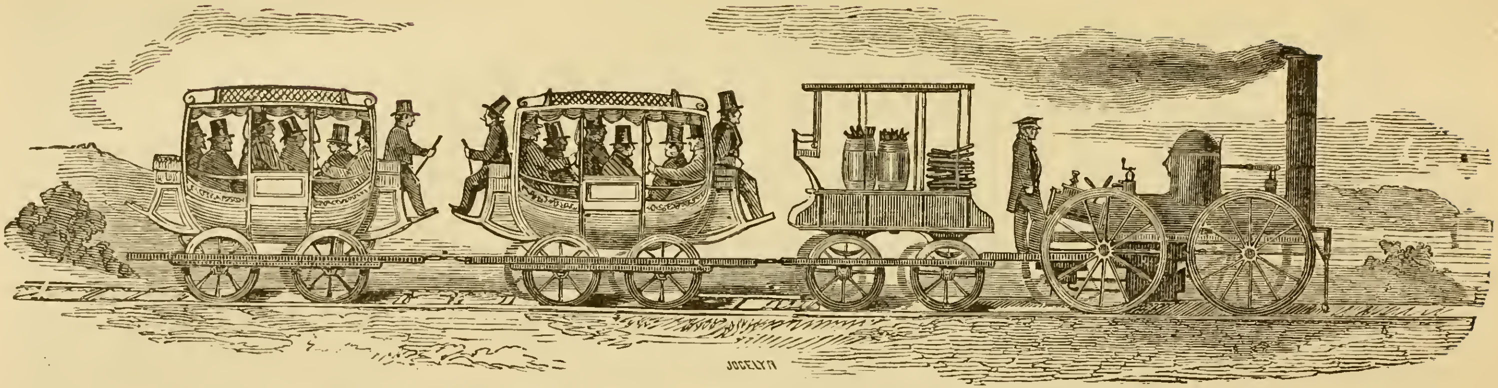
The construction of the Massachusetts Western railway, from Boston to the Hudson river, was one of the most important and financially successful of all the railroads of the country. New York had constructed her great canal, as it were making Albany basin a part of Lake Erie. Boston now grasped the idea of a railroad that should make Albany basin with its affluents a part of Boston harbor. It is to be borne in mind, however, that when that road was undertaken, railroad building was a new art; the mode of laying the track, the form, and even the model of rails were problems. The form of wheels to run on the rails, the mode of setting the car on the wheels, were all unknown compared with the knowledge on the subject which the construction of 90,000 miles of roads in this country has since accumulated. The state of knowledge at that time may be seen in the following extract from "Wood on Railroads" in 1825:—

"Nothing can do more harm to the adoption of railroads than the promulgation of such *nonsense* as that we shall see locomotive engines travelling at the rate of twelve miles per hour."

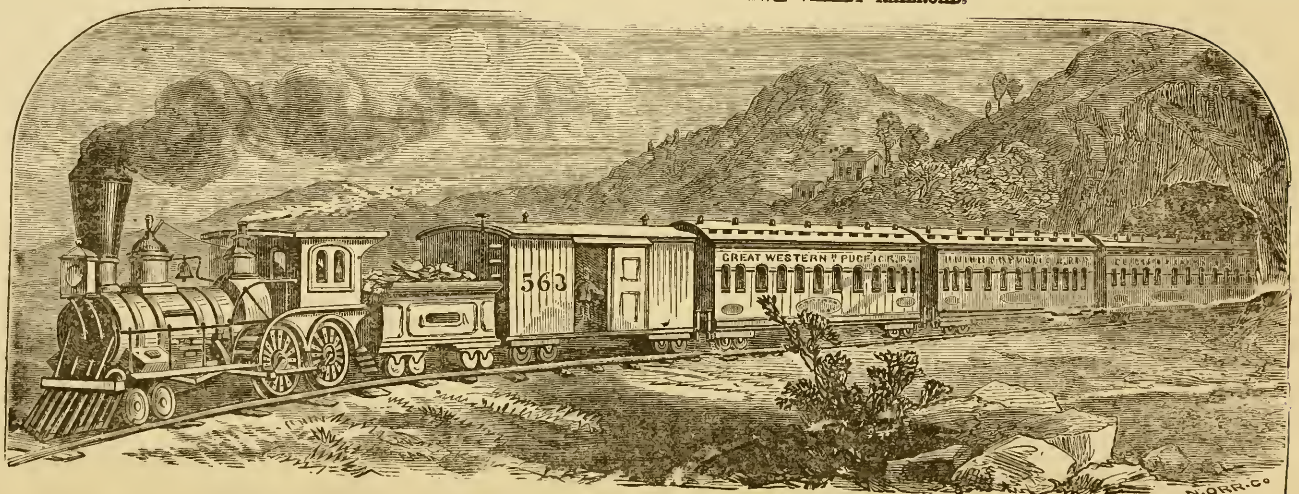
Such was engineering knowledge at the time Boston voted to build a connection 200 miles to Albany. Since that day how much has been learned in relation to the characteristics of roads!

The great advantage of railroads is that they practically diminish distances between places in proportion to the speed attained. The rapidity of motion and power of traction depend upon the diminution of friction. This was sought in common roads, Macadam roads, and canals, but has approached perfection in railroads. The essential attributes are two smooth surfaces for wheels to run on. These being made of iron or steel are narrow as possible to lessen the cost; and to keep the wheels upon the rails, have flanges upon the inner rim of the wheel. The form of iron or steel rails has undergone many changes, as experience suggested improvements. The mode of laying these has also varied. The building of a railroad includes "the road bed," somewhat like a common road, and the superstructure, which embraces rails, supports, ties, etc. The main operations in the construction of the road bed consist in the "excavations, tunnels, embankments, ballasting, bridges, and viaducts."

These operations are required to give the necessary levelness and straightness to roads, both of which are requisite, not only as elements of speed, but of economy. The straightest road is the shortest; but when the road is done, the expense of keeping up the earth-work is nearly nothing, while, on the other hand, the annual expense required to keep up the perishable superstructure is very great and proportionate to the length of the road. Hence true economy requires a greater outlay to make the road straight, in order to avoid permanent cause of expense. Common roads may be lengthened to advantage, in order to avoid an ascent. In railroads this is avoided by tunnels through the obstacle when it is too high to excavate at what it would cost to tunnel. This is not, however, the only reason for straightening, since the frequency of curves greatly increases the danger of railroads.




FIRST LOCOMOTIVE EVER RUN ON THE MOHAWK VALLEY RAILROAD.

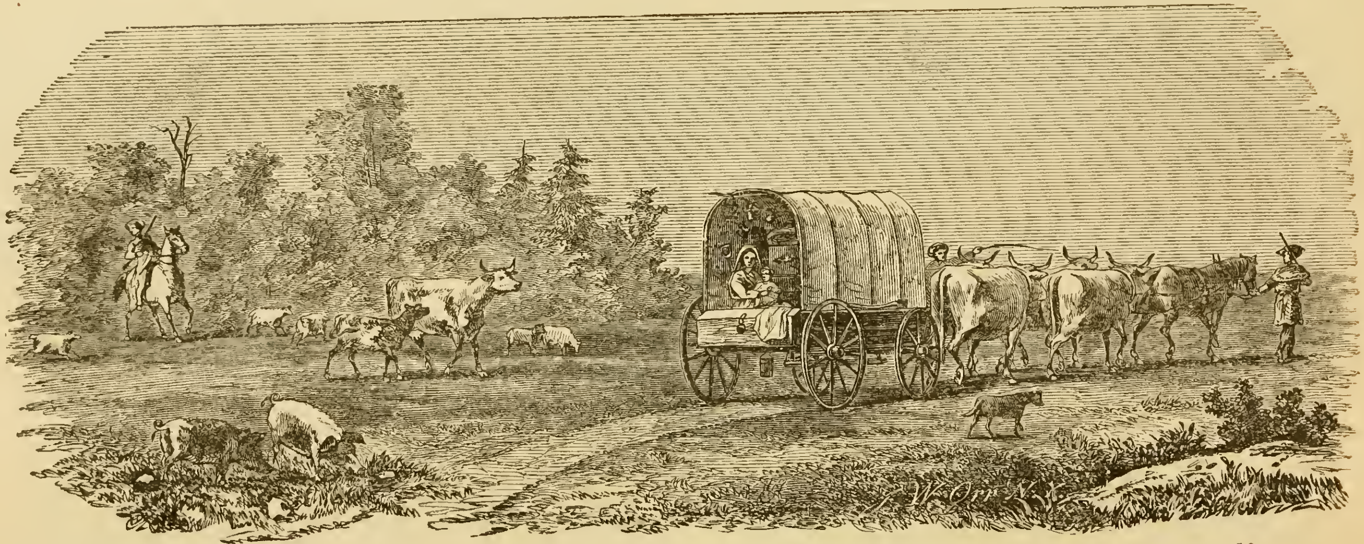



MODERN TRAIN FROM NEW YORK, TO SACRAMENTO CALIFORNIA, WITH PULLMAN'S PALACE CARS.

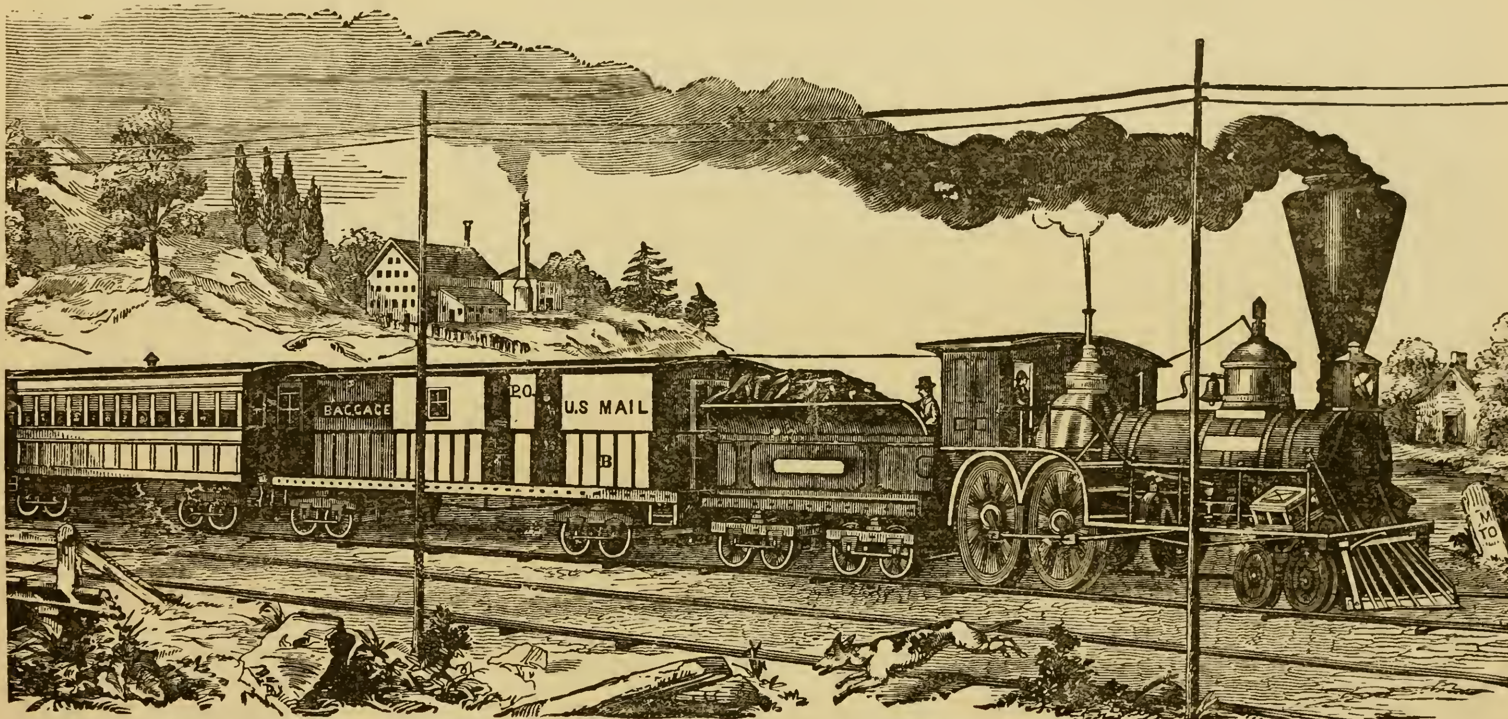
When a car in motion enters upon a curve, it has a tendency to continue its straight course, and this is overcome by the resistance of the flanges of the wheel against the rail, and by the firmness of the outer rail. This resistance is always felt in the rocking motion of the cars, and is increased by the shortness of the curve. A pair of wheels is fastened to an axle and turns with it, the outer wheel moving on a curve much faster than the inner one, which would slide, under such circumstances, if both were of the same diameter, sufficiently to make up the difference. This is obviated by making the wheels conical, or of a larger diameter next to the flange than on the outside. The effect of this is that the wheels having some play between the rails, the outer wheel, forced against the rail, runs on a larger diameter than the inner one, thus compensating the speed. Further, to overcome the centrifugal force, the outer rail is made higher than the inner one, so that the weight of the car gives it a tendency to slide toward the inner one in opposition to the centrifugal force. The excavations in loose earth require to be supported at the sides by retaining walls, and to be drained by ditches and cross drains. In making a tunnel the centre of the road is set with great accuracy on the surface of the ground by an instrument, and shafts are sunk at proper levels along this line. The excavations are then made by "drifts" from shaft to shaft, and to the open ends of the tunnel. The material excavated is raised through the shafts, which serve for ventilation when the tunnel is finished. The embankments require great care to insure their solidity. When the materials for filling are at hand, they are usually made at their full height at one end, and then temporary rails permit the approach of wagons to be emptied over the head of the embankment. The progress of the work depends upon the speed with which these succeed each other. When the track passes through a country like a wooded swamp, where the materials for filling are not at hand, resort is had to trusses. Piles of a diameter of 15 inches are driven, so as to form lines of the width of the railroad; transverse ties are fastened across the tops, and, with proper supports, longitudinal timbers are laid across the piles to carry the rails. The tops of embankments and the bottoms of excavations are made about two feet below the intended or "formation level" of the road, and have there a convex surface like an ordinary road. This space of two feet is filled up with porous material, broken stones, gravel, etc. This is called "ballast," and through it the rains pass freely, and the frosts of winter do not so much affect it. On this "ballast" the sleepers are laid. Many roads are not properly ballasted, and are, therefore, unsafe. Bridges are difficult of construction, and have sometimes been made of iron. This was the case with the Erie railroad, when an accident occurred, because the iron, resting upon stone piers, contracted by the cold so as to drop off its support.

When the road bed is complete, the superstructure is put on. This is now done by cross sleepers. The best of these are second-growth chestnut, 7 feet long, and 8 by 12 inches. These are laid upon the ballast. The iron rails are laid upon these, but in some cases longitudinal timbers are first laid down, and upon these the iron rails are laid. The iron rails have undergone many improvements. At first, a simple flat iron rail was spiked down to these timbers. These rails would often get loose, and the end rising form a "snake head," and the wheel catching under, throw it up with great force and danger to passengers. These roads were ridiculed as "hoops tacked to a lath." Various forms and weights of rail were adopted as experience directed; that now the favorite is called the T rail; the shape is like that letter inverted. There must be a certain breadth of rail for the wheel to run on, and depth for strength. The smallest rails will weigh 36 lbs. to the running yard. The Massachusetts roads use 60 lbs. to the yard; the New York roads, 70 to 75 lbs. to the yard. The rail is not fastened directly to the timber, but is held in chairs, which are spiked to the cross sleepers. The chair is of cast or wrought iron, and will weigh 20 to 30 lbs. They are made in one piece, so as to receive the ends of two rails, which are fastened by wedges of iron or wood, driven between them and the chair, without interfering with the longitudinal expansion and contraction of the rails.

The proper breadth of rails apart, or the width of the track, has been matter of much discussion. There were three gauges in use, to which a fourth has been added of late years. The common gauge on the eastern roads was 4 ft. 8½ in., on the western roads, 4 ft. 10 in. The Erie road and some others, in imitation of it, were of a



EMIGRATING FROM CONNECTICUT TO EASTERN OHIO IN 1805, DISTANCE 600 MILES, TIME 90 DAYS, NUMBER OF PASSENGERS 10.




MIGRATING AT THE PRESENT TIME FROM CONNECTICUT TO IOWA, DISTANCE 1300 MILES, TIME 3 DAYS, NUMBER OF PASSENGERS 360.

six-foot gauge, and were very pleasant; but the expense of their maintenance of this gauge was so great that most roads have abandoned it, and the main line of the Erie is now 4 ft. 8½ in. Many of the western roads recently built, or now building, in Colorado, New Mexico, Texas, Arizona, and Mexico, are built on what is known as the narrow gauge, three feet between the rails. Most of these are single track roads.

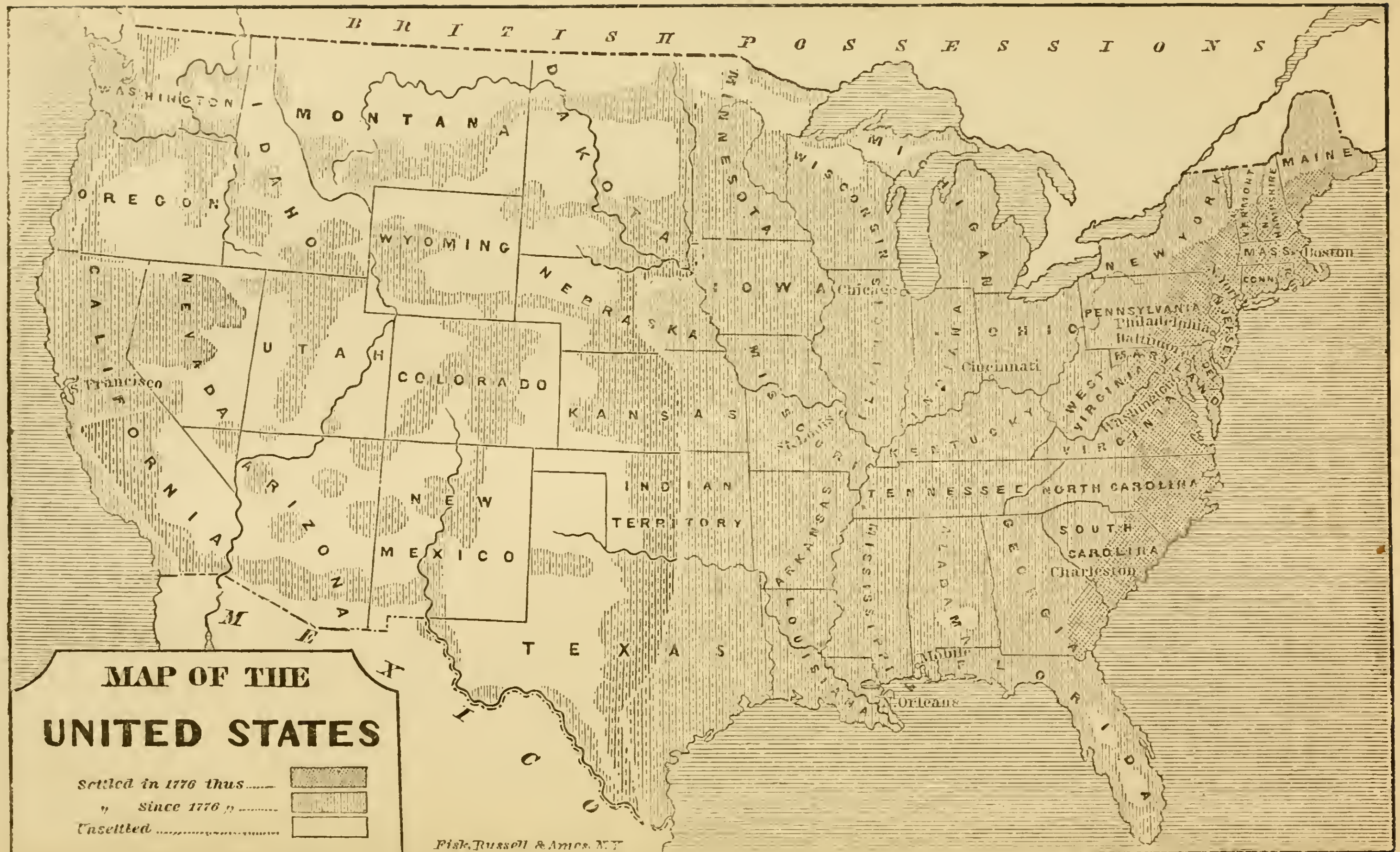
The power on railroads is mostly steam, but horses, stationary engines, condensed air and electricity are sometimes used. The first really successful locomotive was built in 1814, which drew 30 tons 6 miles per hour; improvements have since been made until 90 miles per hour is attained. The power of an engine depends upon the quantity of steam it can generate in a given time. Each revolution of the wheels corresponds to a double stroke of each piston, or four cylinderfuls of steam. The utmost heating surface is therefore required, and this is obtained by tubular boilers. Wheels, 7 feet in diameter, pass over 22 feet in each complete revolution. To go 25 miles per hour, therefore, they must revolve five times in a second, and each piston must make 10 strokes in the same time. This minute division of time is accurately made by this ponderous machine. This rapid exhaustion of steam causes a greater demand for fuel in proportion to the speed. The power of an engine to draw loads depends upon the pressure of steam, which is usually 50 to 60 lbs. to the square inch; but the adhesion of the engine to the rails must be great, otherwise the wheel would slip round. For this reason the wheels were first made with cogs to hold in the rail, but it was found that the weight of the engine was sufficient on level roads. The adhesion of iron upon iron is one-eighth of the weight, but in wet and freezing weather it is greatly reduced, and it lessens with the increase of the slope of the road, or ascending grade. Thus, if an engine will draw 389 tons on a level, it will draw but one-fourth of the amount up a grade 50 ft. to the mile. The average cost of locomotive power is not far from 50 cents per mile run, which includes fuel, oil, wages, repairs, wear and tear, etc. These expenses are, of course, lessened by levelness and straightness, since where these are perfect, more is carried for the same money, than on common roads. A great draw-back upon the cheapness of rail transportation is the weight of the rolling stock. The cars and engines usually are to the paying freight as 10 to 6. Various means have been proposed to lessen the burden of this expense, and recently with some success. It is evident from this slight sketch of the principles of railroad construction that the characteristics of a road, in relation to curves, grades, etc., have much to do with the economy with which it can be run, and its capacity to compete successfully with rival lines.

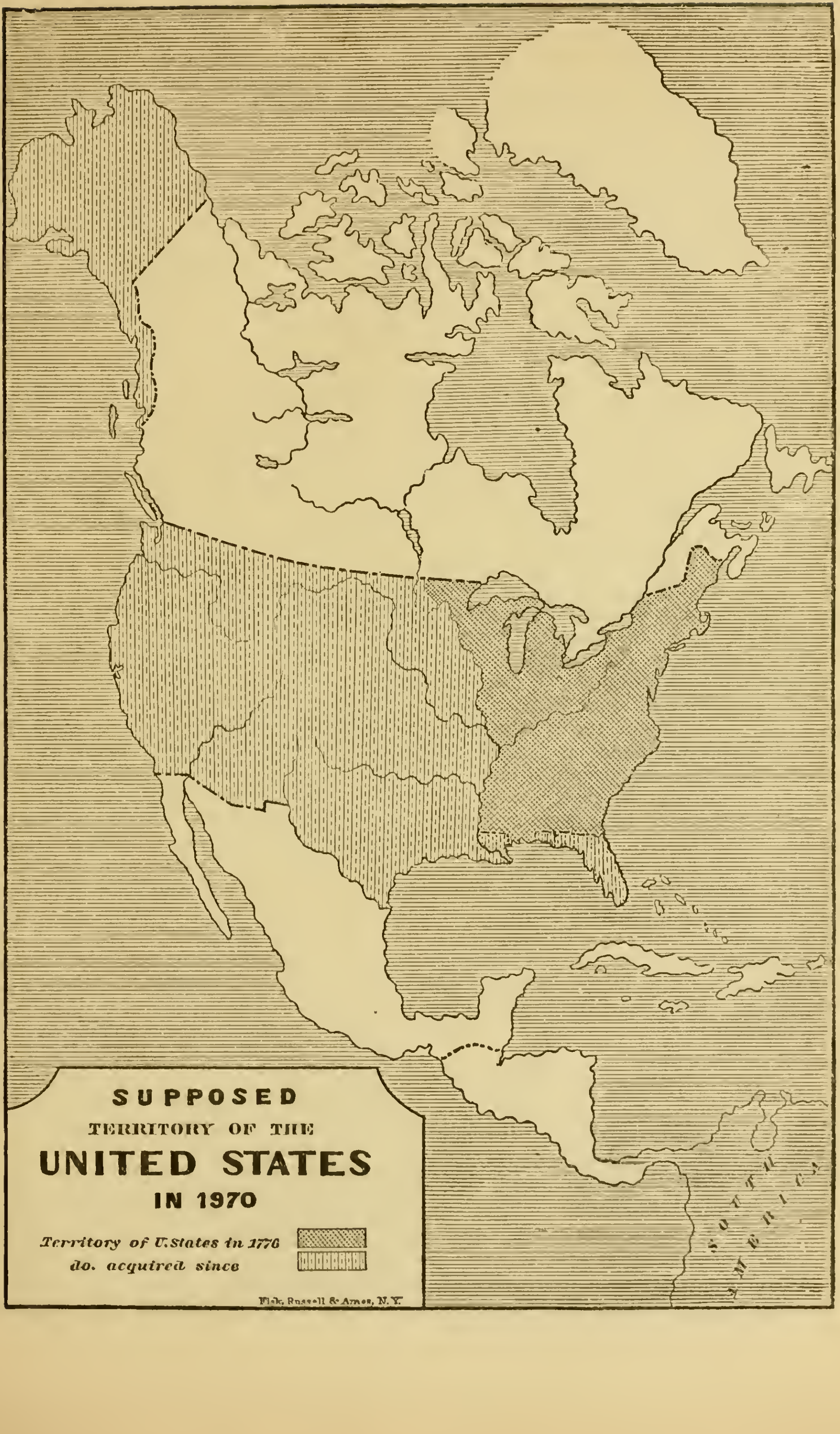
The city of Boston was, as we have said, one of the earliest to understand the advantages that were to be drawn from railroads in overcoming the disadvantages of its position in relation to the west, and the Western railroad has been the instrument by which she made the great states west of New York subservient to her interests. The charter of that road is dated March 15, 1833. The road runs from Worcester, 44 miles west of Boston, to the Massachusetts state line, and thence 38¼ miles over the Albany and West Stockbridge railroad, leased and operated by the Western road, into Albany, 200 miles from Boston. The first train of passengers that left Boston was on April 7, 1834, for Davis' Tavern, Newton, to which place the Worcester road was then opened. It was completed to Worcester July 3, 1835. The Western road, in continuation, was opened to Springfield Oct. 1, 1839, ten days before the United States Bank finally failed, and it reached Greenbush Dec. 21, 1841, thus establishing the route from Boston to the Albany basin in seven hours. It there connects with the New York Central road, which carries the line 229 miles to Rochester, whence, by the Lockport division of the Central road, 77 miles, it connects at Suspension bridge with the Great Western Canada road, and thence with the Michigan Central, the Illinois Central, and the Ohio and Mississippi roads to New Orleans. By this route Boston and St. Louis, 1,365 miles distant, are connected in 64 hours. From Buffalo the line connects south of the lakes with all the net-work of Ohio and other roads. Every portion of the country is thus brought into connection with Boston.

The Boston and Albany road has a double track for its entire length, of very heavy iron. Its length, including branches, is 241 miles. It crosses the Connecticut at Springfield by a fine bridge, 1,264 feet long, and has run a track across the Hudson river bridge at Albany, so passengers can go to Chicago or Omaha from Boston without changing cars. The grades on this road in western Massachusetts are very steep for more than 18 miles, ranging from 60 to 80 feet to the mile. For some years after its completion no road in the United States, except the Pennsylvania and Baltimore and Ohio, had such heavy grades; some of the western roads have a grade of 186 feet to the mile. The cost of the road and equipment was $15,750,960, but its property, including lands, is now valued at $22,636,550, its shares, in 1870, being held above 140 dollars. Its capital stock outstanding is $14,934,100 at par value, and its outstanding bonds $3,442,520. Its gross earnings, in 1869, were $6,074,605, and the net earnings, $1,198,432. The distance between Boston and Albany, in a direct line, is about 150 miles, and but for the passage of the Hoosic mountains the railroad passage between the two cities might be shortened to at least 160 miles by railroads now in progress. To accomplish this, the state was for many years engaged in boring a gigantic tunnel through these mountains. This tunnel passes through the Hoosic mountains; it is about 4¾ miles in length, wide enough for two trains to pass each other without any danger of collision, and is driven through very hard and dense rock. It has a shaft near the center rising to the top of the mountain, 1,028 feet, which aids in ventilating it. It was 22 years in building, and cost about $13,000,000. Its western portal is about 37 miles east of Albany, but the route from the western exit to Troy is very circuitous and is 54 miles in length. It has now come under the substantial control of the N. Y. Central and Hudson River railway, and the project of running a line direct from Albany to North Adams has been abandoned for the present at least. The road and the tunnel have not realized the hopes of their projectors, and have not materially shortened the line between Boston and the West.

Boston is now connected with the Hudson River by numerous lines, some of them all rail, others part rail and part steamer. Like all the rest of New England, Massachusetts is now gridironed with railroads, and the 6,031 miles which traverse that section have greatly fostered the industry and wealth of the eastern states. While, notwithstanding the competition, the immense traffic has made most of the routes profitable.

In New York the question of railroads had been very early discussed. A publication of Colonel Stevens, of Hoboken, in 1812, advocated a railway instead of a canal to the lakes; but his proposition was opposed by Chancellor Livingston on grounds which indicate very odd ideas of the nature of the works. The first regular application to the legislature for a railroad charter seems to have been made by Stephen Van Rensselaer and others in 1826, for power to construct one between the Hudson and the Mohawk, and they received the grant for the reason that no railroads were then in the country at all, and that, as the petitioners were willing to make the experiment at their own cost, it was a good opportunity to permit it. The surveys for the road were not made until 1830, and the road was opened in September, 1831, and three cars, with twenty passengers in each, were drawn to Schenectady in 46 minutes by an American engine of 3½ tons. Meantime, the charters of the Harlem and the Saratoga and Schenectady had been granted. The opening of the Mohawk road caused much excitement. A road from the Hudson to the lakes was agitated, and applications were made to the legislature of 1832 for 49 roads, of which 27 charters were granted, and of these six have been constructed, viz.: the Brooklyn and Jamaica, Hudson and Berkshire, Erie, Rensselaer and Saratoga, Tonawanda, Watertown and Rome. In 1833, six railroads were chartered; of these the Utica and Schenectady, Whitehall and Rutland, and Buffalo and Black Rock were constructed. In 1834, ten railroads were chartered, and of these five were constructed: the Auburn and Syracuse, Buffalo and Niagara Falls, Long Island, Lockport and Niagara, and the Saratoga and Washington. In 1836, 43 railroads were chartered, seven of which were built: the Albany and West Stockbridge, Attica and Buffalo, Auburn and Rochester, Lewiston, Schenectady and Troy, Skaneateles, and Syracuse and Utica. In 1837, 14 railroads were chartered, but none of them have been constructed. In 1838, the state authorized a loan of its credit to the extent of $3,000,000 to the Erie railroad, and of $100,000 to the Catskill and Canajoharie, and of $250,000 to the Ithaca and Owego; also, $200,000 to the Auburn and Syracuse. In 1839, the Oswego and Syracuse railroad was chartered; and the city of Albany lent $400,000 to the Albany and West Stock-


MAP OF THE
UNITED STATES
Settled in 1776 thus
" Since 1776 "
Unsettled
BRITISH POSSESSIONS
MEXICO
WASHINGTON
OREGON
CALIFORNIA
IDAHO
MONTANA
DAKOTA
WYOMING
NEVADA
UTAH
COLORADO
ARIZONA
NEW MEXICO
NEBRASKA
KANSAS
INDIAN TERRITORY
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
MASS.
CONN.
N. JERSEY
MARYLAND
DEL.
Francisco
Chicago
Cincinnati
Philadelphia
Baltimore
Washington
Boston
Charleston
Mobile
N. Orleans
Fisk, Russell & Ames, N.Y.


SUPPOSED
TERRITORY OF THE
UNITED STATES
IN 1970
Territory of U.States in 1776
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Fisk, Russell & Ames, N.Y.

bridge road. In 1840, acts were passed in the legislature to loan the credit of the state to the extent of $3,478,000 to six roads, and provision was made for a sinking fund to be paid into the treasury by the railroad companies, except the Erie. In 1841, the city of Albany was authorized to invest $350,000 in the Albany and West Stockbridge road. The Erie railroad, having defaulted on its interest, was advertised for sale by the comptroller, but the sale did not take place. This was not the case with the Ithaca and Owego, which was sold for $4,500, and the Catskill and Canajoharie for $11,600. The loss to the state was $1,026,327. In 1844, the several railroads from Albany to Buffalo were, for the first time, permitted to transport freight on the closing of the canal, by paying the state the same toll as the canal would have paid. In 1846, the Hudson River and the New York and New Haven were chartered. In 1847, the seven roads making the line from Albany to the lakes were required to lay down an iron rail of 56 lbs. to the yard. They were likewise authorized to carry freight all the year by paying canal tolls; and all the railroads were made liable for damages in case of death by neglect of the companies' agents. In 1848, the general railroad law was passed. The law provides, however, that the legislature shall decide whether the "public utility" of the road justifies the taking of private property. This was removed in 1849. Thus, from 1826 to 1850, 151 charters were granted, and of these 30 have been carried into effect. We observe that the line from Albany to Buffalo was composed of seven distinct companies, finished at different times. Most of these were restricted as to fares. The Mohawk and Hudson—or Albany and Schenectady—was not restrained. The others were, as in the following table composing the line now known as the Central railroad:—

| | Chartered. | Opened. | Maximum fare per mile. | Length. Miles. | Cost. |
|---|---|---|---|---|---|
| Albany and Schenectady .. | 1826 | 1831 | .. | 17 | $1,711,412 |
| Utica and Schenectady... . | 1833 | 1836 | .4 | 78 | 4,143,918 |
| Syracuse and Utica..... .. | 1836 | 1839 | .4 | 53 | 2,490,083 |
| Auburn and Syracuse...... | 1834 | 1839 | .5 | 26 | 1,011,000 |
| Auburn and Rochester..... | 1336 | 1841 | .4 | 78 | 4,210,101 |
| Tonawanda.... ........... | 1832 | 1842 | .4 | 43½ | 1,216,820 |
| Attica and Buffalo .. . ... | 1836 | 1842 | .3 | 31½ | 906,915 |
| Total..................... .......... | | | | 327 | $15,690,249 |

These companies were in 1850 allowed to carry freight without the imposition of the canal tolls, and in 1853 were all consolidated in a single company—the New York Central. When this project of consolidating was under consideration, the stocks rose rapidly to high premiums, and the principle of consolidation was to create scrip stock to the amount of the aggregate premiums, and divide this *pro rata* among the stockholders of all the companies. That scrip, to the amount of about $8,100,000, now figures as a part of the cost of the road. The road was straightened so that the direct line was only 298 miles from Albany to Buffalo, but the other lines and routes added to it make the whole 594 miles. The capital stock of the company, Sept. 30, 1868, was $28,780,000 and there was an indebtedness of $11,526,000, mostly in bonds. The total earnings of the road in 1854, the year of the consolidation, were $5,918,332. From this sum they had risen, in 1857, to $8,027,259, but receded to $6,200,000 in 1859. From 1865 to 1868 inclusive, they averaged $14,350,000 per annum.

In 1869 it was consolidated with the Hudson River railroad, declaring the same year a stock dividend (watering the stock) to the amount of nearly 24 millions, and the capital of the consolidated road was called 75 million dollars, though its cost had been less than 45 millions. Eleven years later, the capital was further watered so as to be stated at $89,428,300, and the funded debt at $40,418,508 more, while the cost of road and equipment was stated at $137,757,152. The New York Central (from Albany to Buffalo), has four tracks, and the whole line is laid with steel rails. Its gross receipts are from 28 to 30 millions of dollars, and its net earnings from 10 to 11 millions, enabling it to pay an 8 per cent. dividend on its enormously watered stock. The stock is quoted at about 145.

The great southern tier of counties bordering on northern Pennsylvania, were for ten years after the completion of the N. Y. Central without means of communication with markets, except by common roads. The face of the country was too rugged to permit of a canal, but in 1825 the state legislature ordered the survey of a state road from Lake Erie to the Hudson river. Several conventions were held during the four years ending with 1830 in relation to the road. The railroad fever had gained ground meantime, and finally, in 1832, a charter for a railroad was granted, with a capital of $10,000,000. The survey was made by De Witt Clinton, Jr., but the legislature required that $1,000,000 of the capital should be subscribed before the work was commenced. This was subscribed, and E. Lord chosen president in 1833. A new survey was made at the expense of the state, and the report made on it in 1835, when a reorganization of the company took place, with J. G. King president. The subscription of capital now reached $2,362,100. The work was commenced by putting 40 miles along the Delaware river under contract. The great fire of December, 1835, incapacitated many of the subscribers from paying up, and work was suspended. In January, 1836, the legislature loaned its credit for $3,000,000, but the stock could not then be negotiated. Some work was done along the line, however, by local subscription. In 1840—Mr. Lord again president—the loan act was amended so as to be available, and the company purchased its iron. The terms of the loan permitted the state officer to deliver to the company $100,000 of state stock whenever he should have evidence that the company had expended an equal amount; the state stock not to be sold under par. The company then paid its contractors with time drafts. The receipts for these drafts furnished the evidence of the company's expenditure, on which the state officer issued the stock to the company, which then borrowed on it the money to take up the drafts, and the lenders of the money sold the state stock in the state for what it would bring—some lots as low as 80. The work thus done was in detached lots, as the interest of certain parties prompted the expenditure. As soon as the last issue was made by the state the company stopped, and the state assumed the interest on the $3,000,000 issued to it. In 1842 the company assigned, and its affairs fluctuated until 1844, when Mr. Loder was elected president. In 1845 the state surrendered its lien of $3,000,000 upon the road, and authorized the individual stock to be cut down one-half by holders giving up two shares and taking one new one. A new subscription of $3,000,000 was obtained, and the work commenced anew. Much of the old work was useless; and at this day, when the passenger approaches Dunkirk, he sees, stretching out far away to the right, like an immense army of grim warriors, the piles that were driven originally for the road, at great expense, and then abandoned. From the year 1845 the road began to grow. Starting from Piermont, on the North River, 20 miles above the city, it reached Otisville, 62 miles, in October, 1846. The route was altered, and reached Binghamton, 139 miles, in December, 1848, at a cost of $9,802,433, allowing $1,458,000 for half the old stock, after the release of the state lien. In June, 1849, 22 miles more to Owego were opened; in October 36½ miles were added to Elmira; and it finally reached the lake at Dunkirk, May, 1851. This was a single track, and it was found almost impossible to work it; consequently they put a second track under contract on portions of the road. It was now found that the location of the road at Piermont, to be reached by steamboat, would not answer. The company then made an arrangement with the Paterson and Ramapo road to allow the Erie to come into Jersey City. The Erie railroad being a wide gauge, 6 feet, and the Paterson road 4 feet 8 inches, it became necessary to lay another rail outside the track, to permit the Erie cars to come over that road, and the Erie cars reached Jersey City in November, 1853. It is remarkable in relation to this road, that it has depended upon the telegraph to such an extent that it could scarcely be operated without it. It gives constant information of the whereabouts of the trains and the condition of the track, so that the superintendent, wherever he may be, keeps up a constant communication with all the stations. The whole length of the road is 460 miles; 486 miles double track and sidings. The maximum grade of the road is 60 feet to the mile for 8 miles, and there is one of 57 feet to the mile. The cost of the road was greatly enhanced by the mode of raising money for its construction, by a constant series of loans, for which were issued first mortgage bonds, second mortgage bonds, bonds convertible in stock in 1862, bonds convertible in 1871, income bonds, unsecured bonds, and other debts, for very few of which the face was obtained, many of them being disposed of at a large discount. By these means the debts of the company ran up to $25,260,000, and the capital, $10,000,000, was in February, 1857, by a dividend of 10 per cent. in stock, money alleged to have been earned and sunk in the Long Dock, raised to the sum of $11,000,000. This load of debt exceeded the ability of the company, and it went finally into the hands of a receiver. The length of the road at that time was 446 miles, with a branch of 19 miles from Chester Junction to Newburgh, 460 miles in all. It leased of other companies, 95 miles, consequently operated 560 miles. It had in 1868, 371 locomotives, 187 passenger cars, 300 emigrant and baggage cars, and 5,856 freight cars.

The management of the road was never characterized by any marked financial ability, and in August, 1857, in consequence of the great cost of constructing the Bergen tunnel, and other financial blunders, it defaulted on its interest, and its stock was wiped out. The unsecured bonds and the later mortgages were capitalized into a stock known thenceforth as the Erie railway, and the coupons of the first, second, and third mortgages were extended. For a time it seemed likely to prosper, as its business was large and apparently profitable ; but it had fallen into the hands of reckless and dishonest speculators, who sought only their own profit. Previous to the reorganization in 1859 its stock was sold at $5 or less per share. The stock of the new organization was, at first, nearly par, but under the management of Fisk and Gould it was down till it was as low or lower than the first stock, and passed into the hands of receivers in 1873, and after some years was reorganized in 1879, as the N. Y., Lake Erie and Western Railroad Co. Its common stock now stands at about 45 or 46; its preferred stock at 61 or 62. Previous to the completion of the reorganization its capital stock was stated (Jan. 1, 1880) at $83,247,000; its funded and floating debt was $75,391,973. The total cost of road and equipment was stated at $158,-035,707, a very large portion of which had been squandered. It does not as yet pay any dividends. Its receipts in 1879 were $18,613,109, and its expenses $10,644,000, showing net earnings of $7,049,084. It operated 1,829¾ miles of track in New York.

The Camden and Amboy railroad and Delaware and Raritan Canal Co., of New Jersey, is one of the oldest passenger roads, having been chartered in February, 1830, with the canal privilege. The last is 43 miles from Bordentown to New Brunswick; and the former, South Amboy to Camden, New Jersey, 63 miles. The Camden and Amboy road was opened to Camden in 1834. In 1831 the company gave the state 1,000 shares of stock, and a new act was passed, consolidating the canal and railroad companies; fares not to exceed $3 between New York and Philadelphia. In the following year 1,000 shares more were conveyed to the state. In 1837 the road was permitted to extend to New Brunswick; fares limited to 5 cents per mile. In 1842 the transit duties on the road were fixed at ten cents per ton for freight, and one-half of all above $3 charged for passengers. In 1843 a *quasi* union was effected between this road and the New Jersey railroad, extending from New York to New Brunswick, by which a through line was established. Both roads have been very profitable. On the expiration of the contract between the State of New Jersey and these railroads, they were leased as the United Railroad Companies of New Jersey, on long time, by the Pennsylvania Central Railroad Co. These roads constitute the New Jersey Division of the Penn. Central R. R. Co.

The New Jersey Central road extends from the foot of Liberty street, New York city, to Easton, on the Delaware; and by its close connections with the Baltimore and Ohio, the Pittsburg, Fort Wayne and Chicago, the Lehigh Valley (a coal road) etc., it forms one of the best through routes to the West. Its cost was reported in 1874, including its branches and leased lines, as $56,000,000 in stocks and bonds, but in that year it defaulted on its interest and was put into the hands of a receiver. During the present year, 1881, it has resumed its position as a sound and valuable road.

The great Pennsylvania line of improvements, from Philadelphia to Pittsburg, commenced 4th July, 1826, and completed in March, 1830, comprised 82 miles of railroad from Philadelphia to Columbia, and 36 miles of portage road from Hollidaysburg to Johnstown; this consisted of a series of inclined planes, which were worked by stationary engines. This 118 miles of railroad was prolonged by 278 miles of canal, and the cost of the whole to the state was over $12,000,000. The citizens of Philadelphia felt the need of works better adapted to the growing wants of that great city; and a new railroad was proposed from Harrisburg to Pittsburg, 250 miles. The route is favorable, except for the mountain division, where the summit is crossed 2,200 feet above tide water, requiring gradients 95 feet to the mile. These are but little in excess of those of the Massachusetts lines, which are worked to advantage. This work was opened through, November 15, 1832, at a cost of $7,978,000, It proved very successful, and up to November, 1855, its profits, over interest on capital, were, in accordance with its charter, credited to construction account, and it has since paid 6 per cent The state line of public works did not succeed financially, and the state determined to sell it. After repeated offerings it was finally purchased by and transferred to the Pennsylvania railroad in 1857 for $7,500,000, which was met by an issue of the 5 per cent. bonds of the company to the state, payable, $100,000 per annum until 1890, and the balance, $4,300,000, in four equal instalments annually thereafter. When the road took possession of the state works, the canals were found to be in a dilapidated condition, and the railroad needed repairs, which required assessments. The route then became continuous by rail from Philadelphia to Pittsburg, 366 miles. It had 486 miles of double track and sidings. The original cost of the road was $29,761,533, but aid granted to other lines which are subsidiary to it, made its capital, Jan., 1880, $68,890,200, its bonds, $80,267,756, and its floating debt, $14,631,161. A part of the cost is composed of $8,816,050 advanced to the Pittsburg, Fort Wayne, and Chicago railroad, which prolongs the Pennsylvania road to the latter city. That road was composed of three roads, viz: the Ohio and Pennsylvania, the Ohio and Indiana, and the Fort Wayne and Chicago roads. These were consolidated into one company in 1856, and the line completed from Pittsburg to Chicago in 1859, 468 miles, at a cost of $39,553,586, of which $27,043,586 was capital, and $15,-510,000 bonds. To assist the completion of this road, the Pennsylvania Railroad Company took up the rails on the 36 miles of portage road, which it had bought of the state, and which was of no use, as it run parallel to its own road, and gave them to the Pittsburg road to complete its extension from Plymouth into Chicago. For this iron and the expense of taking up and moving, the Pittsburg road gave its first mortgage bonds for $650,000. The business of the Pennsylvania road, connecting Philadelphia with Chicago and the whole net-work of railroads between and beyond those cities is very profitable. Its gross earnings, in 1879 were $21,-743,628, and its net earnings $9,992,008.

We have stated that a portion of the great Baltimore and Ohio railroad was finished two years before the opening of the Manchester road in England. The company received two charters: one from the state of Maryland, February, 1827, and the other from the state of Virginia in the following March, with authority to construct a road from Baltimore to the Ohio river. The capital authorized was $5,000,000, and the company entitled to organize on the payment of $1,000,000. The company was so organized in April of the same year, and with the aid of several officers of the United States topographical corps, the road was partly located in the same summer. July 4th, ground was broken by Charles Carroll, of Carrollton, and the portion of the road to Ellicott's Mills was put under contract. The capital of the company, at the close of 1828, reached $4,000,000, of which three-fourths was taken by individuals, $500,000 by the city of Baltimore, and $500,000 by the state of Maryland. The road was gradually extended to the Point of Rocks in 1832. Here arose an obstacle of right of way. The Chesapeake canal had appropriated the narrow gorge through the mountain, and several years of negotiation elapsed before the difficulty was finally settled by the legislature. In 1833 the Washington branch was chartered, on the condition that at least 25 cents per passenger should be paid to the state. The Baltimore and Ohio Company contributed $1,016,800 toward the construction, and it was opened 30 miles to Washington, August 25, 1835. The road had then no locomotives, horse power being used. The company offered $4,000 for a locomotive of American manufacture to burn coal. One was invented by Phineas Davis and accepted. It ran 15 miles per hour on short curves and 30 miles on a straight line. The rails were flat bars laid on stone foundations, which soon gave way to longitudinal timbers with improved rails. The road reached Harper's Ferry in 1834, and the state subscribed $3,200,000 for the extension to Wheeling. In 1838 the state of Virginia extended the time for construction through its territory and subscribed $1,058,420. The road was then completed to Cumberland in 1842, but nothing further was done until 1847. Virginia again extended the time, and in 1849 state bonds granted to the company furnished means for pushing the road to completion in 1853. The city of Baltimore then furnished $5,000,000, which was expended in protecting tunnels, double track, etc. There is one tunnel of 4,137 feet, and the length of all the tunnels is 12,804 feet.

A charter for the Parkersburg branch was granted in 1851. The work began December, 1852, and was completed May 1, 1857. The road was built jointly by the city of Baltimore and the Baltimore and Ohio Company. The former gave $1,500,000 first mortgage bonds, and the latter $1,000,000 of its second mortgage bonds, and has since advanced $1,795,326. The road is operated by the Baltimore Company under a contract for five years, at a rent of 40 per cent. of the gross earnings.

The capital of the main line of the Baltimore and Ohio Railroad was originally $17,802,000, and its funded debt $9,343,681. In Jan., 1880, the capital had been increased to $19,792,566, the bonds to $29,386,875, and the floating debt to $1,421,260, a total of $50,600,701. Its two branches, the Washington and the Parkersburg, cost together, $10,018,000 more, making in all over $60,000,000. Recently it has leased and formed connections with several other roads which give it access to Cincinnati, Chicago, St. Louis and the Pacific States, and also to New York city. It has always been largely engaged in the coal traffic, carrying from 525,000 to 550,000 tons annually. It has also developed within the past few years a vast trade in breadstuffs, especially corn and provisions. As the great centre of canned goods of all kinds, fish, oysters, meats, and fruits, its west bound traffic is always very heavy. It pays regularly an 8 per cent. dividend. Its gross earnings in 1879 were $9,809,533, and the net earnings $4,750,909.

The Virginia Central railroad (195 miles), was originally chartered, in 1836, as the Louisa railroad, with a capital of $300,000, and in 1837 the board of public works was authorized to subscribe on behalf of the state $120,000. In December, 1837, twenty-three miles of the road were opened. It was further extended in the following year, and in 1840 the road reached Gordonsville. Under new privileges, granted in 1848, the work was resumed, and reached Charlottesville in May, 1850, but in that year the name of the road was changed to the Virginia Central railroad. There were then seventy miles in operation, and extensions at both ends were proceeded with; of these, in 1851, twenty-three miles were completed, bringing the road into Richmond. In 1857 the road was opened to Jackson's river, 195 miles, at a cost of $5,372,910, of which $3,132,445 was paid up stock, $1,878,493 state aid, and $351,972 floating debt. It was one of the best built roads in the state, and for three years did a good business. During the war it was greatly injured, but in 1866 was thoroughly repaired and put in good running order at a heavy expense. In 1868 the facilities which it offered for becoming a trunk road from Norfolk to the west, attracted attention, its name was changed to the "Chesapeake and Ohio Railroad," and northern capital interested in it. Huntington, on the Ohio, is its western terminus, and from thence it has connections now nearly completed with Cincinnati and Louisville, which will make it one of the trunk roads; its connections with the Norfolk, now in rapid progress, will enable it to ship freight direct to Europe to great advantage. The road has cost about 22 millions. In 1873 it failed and was put into the hands of a receiver, but it has been reorganized (in 1879), and is now prospering. Its stock, bonds, and debts are $51,805,113.

In the summer of 1881 its managers secured a connection for this road with Memphis, and west of the Mississippi with the Texas and Southern Pacific. It thus becomes one of the great trunk roads to the Pacific, and has the advantage of a nearly direct route never obstructed by snow. It will doubtless secure a large share of the Southern traffic.

In casting the eye upon a railroad map, the line from Bangor, Maine, to New Orleans, 1,996 miles, is found to be composed of eighteen grand links; one of the largest of these is that which connects Lynchburg, Va., with Bristol, Tenn., 204 miles. This was called the Virginia and Tennessee. It was opened in 1854. In 1870 this road was consolidated with the Naples and Petersburg and South Side railroads, under the name of the Atlantic, Mississippi and Ohio Railroad, with authority to complete the Virginia and Kentucky division from Bristol to Cumberland Gap. This road has now formed such connections with other roads as to form the most direct route to Knoxville, Tenn., to Mobile, and New Orleans. Its stock, bonds, and debts are about $21,581,006.

The South Carolina road was one of the

first projected in the country. The city of Charleston early saw the advantage and importance of the work, which was commenced in 1830, and opened in 1833. Its main trunk extends from Charleston to Hamburg, on the Savannah river opposite Augusta, Ga., 136 miles, with branches to Columbia and Camden, S. C. The track was originally a trestle-work, on which was laid a thin flat rail. Some of the swamps and rivers were crossed at an elevation of fifty feet. On this road the first successful American locomotive was run. It was called the "Best Friend," and was built under the supervision of E. L. Miller, of South Carolina. It was introduced by Horatio Allen, and ran in 1830, when there were but eight miles of road out of Charleston. The South Carolina road cost $11,-526,231, of which $5,819,265 is capital, and the remainder bonded debt. The road owes most of its business to the transportation of cotton, and it pays 10 per cent. regularly. Its stock is above *par*. The project of connecting Charleston with Cincinnati was early entertained, and in 1836 a grant was obtained from South Carolina, North Carolina, Tennessee, and Kentucky, for the purpose of constructing a road through Columbia, Knoxville, and Danville to Covington, opposite Cincinnati. This enterprise was swamped in 1837 by the crisis, when the road was partially constructed to Columbia. This has since been completed by means of the Spartansburg and Union, and the Cumberland Gap and Charleston railroads, except a short gap between Asheville, N. C., and Wolf Creek, which is now in course of construction.

Georgia has more miles of railroad completed, and more in progress, than any other southern state. Atlanta, Macon, Augusta, Savannah, and Millen are all important railroad centers. There were, in Jan., 1880, 2,516 miles of completed railway in the state, and at least 600 miles more in progress. The most important roads are: The Georgia, extending from Atlanta to Augusta, having a length, with its three branches, of 257 miles, and costing $5,-808,000; the Georgia Central, from Macon to Savannah, with leased lines, 660 miles, costing $12,126,827; the Macon and Augusta, and Macon and Brunswick, which are severally 62 miles, and 174 miles, and together cost $8,491,541; the Atlantic and Gulf, with the Florida branch, 347 miles in length, and costing $8,181,000; the Western and Atlantic, 138 miles in length, from Atlanta to Chattanooga, costing $5,-000,000, and the Southwestern and its branches, 325 miles in length, now permanently leased to the Georgia Central, which has assumed all its liabilities. Several of the lately finished railways are also of considerable importance, especially the Georgia Air Line, from Atlanta toward Richmond, the Brunswick and Albany, and the Athens and Clayton, intended to connect Savannah with Cincinnati. The entire cost of railroads already built in Georgia, up to Jan. 1, 1880, was about $80,000,000.

In Alabama, Louisiana, and Arkansas, their fine rivers, navigable for steamboats, have made railroads almost unnecessary. But whenever they are built, and can obtain a freight of cotton, they are sure to pay. This product is not like corn, or wheat, or even flour, worth one, two, or three cents a pound, but eight, ten, or twelve cents, and can therefore afford to pay the cost of transportation.

Up to the period of the completion of the Union and Central Pacific railroad, the Illinois Central railway was the most remarkable of American roads in the extent of its line, and its mode of construction, under a single corporation. In 1837, when the population of the state of Illinois was less than 200,000 souls, and these agriculturists scattered over the great state, they undertook with singular boldness a system of internal improvement by canal and railroad, which would involve an expenditure of at least $15,000,000. Among these was the Central railroad, which was to extend from Cairo, at the junction of the Ohio and Mississippi rivers, longitudinally through the state, to Galena, at its northern extremity on the Mississippi river, making a line of 457½ miles, which should be the base of a triangle of which the great river formed the other two sides. This road was to cross the Illinois river at the commencement of navigation, or where it meets the canal coming from Chicago. Other roads were projected to cross the state, intersecting the Central road. The Central road was undertaken, and about $3,500,000 spent upon it, when bankruptcy overtook the state, and the road rapidly deteriorated. The progress of the work on the canal, with the funds borrowed on pledge of the land granted by the federal government, had been of great benefit to the state, and had enabled the federal government to sell most of its lands on the canal and great water-courses, in fact, all within reach of market. There remained, however, some 15,000,000 acres of the richest land in the heart of the state, for which there was no sale, because it was not accessible to market. Experiencing, however, the great results from the canal grant, which not only laid open great tracts to market, but by local expenditure in construction, brought settlers and money upon the vacant lands, it decided upon a similar grant to the state in aid of the Central railroad. Accordingly, in September, 1850, Congress made a grant of lands to the state of Illinois of every alternate section, six sections in width, on each side of the road and its branches, and if any land so situated should be taken up, then any vacant land elsewhere might be selected in room of it, within fifteen miles of the line of the road. The same law conferred upon the states of Alabama and Mississippi similar grants for the extension of the road from Cairo to Mobile city. In the following February the state of Illinois incorporated the Illinois Central Railroad Company, with a capital of $1,000,000, to be extended to an amount not exceeding the cost of the road. The company on its organization was to pay over to the state treasury $200,000, and receive from the state the entire grant of lands made by the federal government, together with all that remained of the old Central road, right of way, etc. The company was to have fifty miles completed within two years, under forfeit of the $200,000 deposited, and which was to be returned to the company on the completion of the fifty miles within the time. The road was to run from Cairo to the western end of the Illinois canal, and thence branch to Galena on the river, and to Chicago on the lake. The company was to pay to the state annually five per cent. on the gross income of the road. These were the leading items of the grant, and the conditions were all carried out. The location and survey of the route showed the company entitled to 2,595,000 acres of land to be selected by the company. This vast tract of land, amounting to an area larger than the whole state of Connecticut, was all to be selected from good farming lands, not an acre of waste in the whole, but all of the richest prairie soil, of the same character as that in the neighborhood of St. Louis, which for two hundred years had given to fresh settlers annual crops, without in any degree deteriorating apparently. These lands of the company were appropriated, 2,000,000 acres, valued at $18,150,000, as a security for $17,000,000 of construction bonds; 250,000 acres were added to the interest fund to meet any deficiency of means from other sources appropriated to interest on the construction bonds; and 345,000 acres were held in reserve, but were finally the basis of $3,000,000 "free land bonds," issued and redeemed by conversion into company stock. The 2,000,000 acres were placed in the hands of trustees, who alone have power to give title to purchasers, and who are required, whenever the funds accumulate to the amount of a bond, to buy and cancel it. No land can be sold, unless bonds to the same amount are cancelled. It was estimated that the bonds thus issued would build the road, and leave the entire work free of cost to the stockholders. It was found requisite, however, to create 170,000 shares, representing $17,000,000 capital. On this instalments have from time to time been called in. The $200,000 deposited with the state was assessed $20 on 10,000 shares, and the amount has since been increased to $25,277,270, on which 80 per cent. has been called, making $20,800,000. In April, 1852, $4,000,000 of the 7 per cent. construction bonds were issued at par, and the subscribers to this loan had the privilege of subscribing ten shares of stock for each $1,000 bond. The company purchased their iron, 72,000 tons, in 1852, when it was very low, or less than half the price to which it rose soon after, when the railroad fever developed itself. In October, 1852, the whole line was put under contract, in divisions, and 10,000 men were employed at an expense of $3,700,000 per annum, at work along the line, twelve hours per day, stretching a great highway through fertile plains never before opened, conferring value on them, wealth to the farmers, and strength to the state. As the work progressed, it encountered difficulties from cholera, and the demand for labor which the growing railroad mania caused. The road was opened in 1854, and its earnings for its first year, 1855, were $1,532,118. It had sold, in 1872, 2,215,000 acres of its lands for 24,540,690 dollars, leaving 379,210 acres unsold, mostly desirable lands, in the Central and Southern parts of the State. Most of these have since been sold, and the entire amount reached from its land sales, exceeds $30,000,000. Its main line is 707 miles in length, and it has over 400 miles of leased lines in Iowa, all of which it has since purchased. Its capital stock is $29,000,000, and its bonds in 1880, most of them since redeemed from its land sales, were $12,-100,000. In 1880 and in 1881 it was extending its Sioux City line into Dakota and up the James or Dakota River Valley. Its financial condition is excellent.

At Cairo, the southern terminus of the road, the cars make direct connections with the Mobile and Ohio, and New Orleans, St. Louis and Chicago railroads for Memphis, Natchez, Vicksburg, New Orleans, Mobile, and other southern cities. In Chicago the company's facilities for receiving and forwarding freight are unsurpassed. Sleeping cars are run on all its night passenger trains.

| State or Corporation. | Grants for Internal Improvem't Includi'g State Canals. | Acres Certified up to 1880. | Acres Granted. |
|---|---|---|---|
| Ohio | 1,243,001.77 | .......... | .......... |
| Indiana | 1,609,861.61 | .......... | .......... |
| Illinois | 533,283.73 | .......... | 2,595,053.00 |
| Missouri | 500,000.00 | 1,828,005.02 | 3,745,160.21 |
| Alabama | 500,000.00 | 2,830,571.76 | 3,729,120.00 |
| Mississippi | 500,000.00 | 935,158.13 | 2,062,240.00 |
| Louisiana | 500,000.00 | 1,072,405.49 | 3,178,720.00 |
| Michigan | 1,250,000.00 | 3,229,033 09 | 4,931,361.16 |
| Arkansas | 500,000.00 | 2,381,650.63 | 4,804,871.14 |
| Florida | 500,000.00 | 1,760,468.39 | 2,360,114.00 |
| Iowa | 1,333,079.90 | 4,623,173.46 | 7,207,837.98 |
| Wisconsin | 1,183,728.42 | 2,807,783.88 | 3,758 436.07 |
| California | 500,000.00 | .......... | 3,520,000.00 |
| Minnesota | 500.000.00 | 7.279,484.15 | 9,913,495.95 |
| Oregon | 500,000.00 | .......... | 4,700,000.00 |
| Kansas | 500,000.00 | 3,872,191.21 | 6,870,000.00 |
| Nevada | 500,000.00 | .......... | .......... |
| Nebraska | 500,000.00 | .......... | .......... |
| Pacific R. Rs. &c. | .......... | 10,435,048.08 | 151,144,766.00 |
| Wagon Roads. | | | |
| Wisconsin | .......... | 302,930.36 | .......... |
| Michigan | .......... | 221,013.35 | .......... |
| Oregon | .......... | 777,096.76 | .......... |
| Total | 13,153,155.43 | 46,951,066.80 | 214,031,807.97 |

The most marvelous result of this great work was manifest in the report of the United States land commissioner. The lands through which the road ran had been offered on an average of 15 years at $1.25 per acre, without finding a buyer. All those lands were withdrawn while the company made its selections. When that was done, the lands were again brought into market, in June, 1852, and these in the next twelve months sold in Illinois 298,861 acres for cash, at $2.50 per acre, and $2,509,120 for land warrants. The sales were double the quantity sold in all the states in the previous year. The whole interest of the government in Illinois was speedily closed out. For lands which had been valueless to it before the completion of the road, it realized over $9,000,000. This was the effect of transportation upon those lands.

The first land grants of the government were in aid of canals (included in the grants for internal improvements.) We give above, also, the grants to railroads up to July, 1880. Of these 607,741.76 acres have been declared forfeited by Congress.

The land grant of the federal government to Alabama for the Mobile and Ohio road was to the extent of 1,120,000 acres, and it became the basis of a sinking fund for the aid granted to the states of Tennessee, Mississippi, and Alabama. The road extends from Mobile bay, in a line nearly due north, to the mouth of the Ohio river, opposite Cairo, a distance of 506 miles. Thence by the Illinois Central it connects with Dunleith, on the upper Mississippi, 928 miles, and also with Chicago and the eastern lines. The road was commenced in 1851, and was nearly completed before the war. It is now doing a prosperous business and has cost $21,730,715.

The Mobile and Ohio is not by any means the only railroad line to the Gulf and to the S. E., as well as S. W. portion of the United States. East of the Mississippi there are three rival routes to the Gulf, viz., the combination of several railways known as the New Orleans, St. Louis and Chicago, which is, on the whole, the most direct to New Orleans; the combination known as the Louisville, Nashville, and Great Southern, whose direct termini are Chicago and Pensacola, but which, through branch railroads reaches Mobile and New Orleans on the S. West, and Atlanta, Jacksonville, Savannah and Charleston in the S. E., and later still, the Cincinnati Southern, which is connected to the north with Michigan, and by other roads, with Chicago, and has formed connections southward from Chattanooga with Brunswick, Ga., Savannah, and Charleston. These combination roads are only in alliance for the purposes of traffic and not a consolidation under a single head. West of the Mississippi there are two principal lines, the St. Louis, Iron Mountain and Southern, and the Missouri, Kansas and Texas, both connecting with the Gulf as well as with other points by other roads, of which the International and Great Northern, and the Houston and Texas Central were the principal. Recently it is reported that all of these roads have been consolidated with others in the grand scheme which Jay Gould and his associates have been arranging for the control of the railroads of the southwest, and of Mexico. What are to be the amounts of stock and bonded indebtedness of the consolidated roads, have not yet transpired, but they must be very large, as the reports of the cost of the four roads named, Jan. 1, 1880, were as follows:

| | |
|---|---|
| International and Great Northern | $18,489,202 |
| Houston and Texas Central | 30,919,587 |
| Missouri, Kansas and Texas | 47,210,332 |
| St. Louis, Iron Mountain and Southern | 51,043,893 |
| Totals | $147,663,014 |

It should be observed that the International and Great Northern, and perhaps also the Houston and Texas Central are expected to make close connection with the Mexican railways extending to the City of Mexico and the Pacific Coast in Mexico.

Still farther west, in Arizona, the Atchison, Topeka, and Santa Fe, and the Denver and Rio Grande are finding access to the Pacific Ocean at Guaymas and other ports on the Gulf of California, and at San Diego, Los Angeles and other ports on the Pacific.

The State of Michigan, in 1836, contemplated the construction of three railroads to cross the state: the Southern, from Monroe to New Buffalo; the Central, from Detroit to St. Joseph; and the Northern, from Huron to Grand River. For these roads a state debt of $5,000,000 was contracted; and, in 1838, 28 miles of the Central road had been put in operation, which was extended to 146 miles, at a cost of $2,238,289, and the Southern road, 68 miles, at a cost of $1,125,590, when the state failed and repudiated its debt. As a step toward recovery, a bill was passed, at the suggestion of Mr. Charles Butler, of New York, called the "Butler act," by which the state sold the Central road to a Boston company for $2,000,000 of its own bonds, and the Southern road for $5,000,000 to another company. Little was done, however, until 1849, when Mr. Butler and others reorganized the Southern company, and the road was pushed to completion. As it approached the Indiana line, an old Indiana state charter was purchased, enabling the company to carry their work through that state to the Illinois line, whence, under the general law of that state, it was pushed on to Chicago. The distance from Monroe, on Lake Michigan, to Chicago, is 246 miles, and the work was completed for $50,000,000, or $20,000 per mile in running order, the level nature of the country being very favorable to the construction of railroads. The work was eminently successful, but became involved through its connection with lateral jobs, which covered it with liabilities greater than its business, large as it was, could carry. In 1857 it became so much embarrassed, as to be obliged to reorganize, and was subsequently consolidated with the Lake Shore railroad. It has now a length, including one branch of 1,176.8 miles; its cost for road and equipment is set down at $89,926,308 of which $50,000,000 is represented by stock and $39,926,308 by debt. Its gross earnings for the year ending Dec. 31, 1879, were $15,271,492, and the net earnings $6,336,968. It is now run in close connection with the N. Y. Central railroad, and its stock is about par. It has, for two or three years past, made from 6½ to 8 per cent. dividends.

The Michigan Central reached the lake in May, 1849, and was also pushed to completion, going around the head of Lake Michigan, where the Illinois Central put out a hand to meet it. The length of the line is 803.7 miles, Detroit to Chicago. The cost of this road was $35,350,683. The road was laid with T rail, and is very prosperous. The capital of the company is $18,738,204 and the debt $13,691,000. The road is an important link in the line of connection between Boston and the western country.

The state of Tennessee has an important system of railroads extending to all sections of the state. The state guarantees $8,000 per mile for the purchase of iron and equipment, upon the condition that the companies prepare the road-bed and defray the charges of construction. The state retains a lien upon the whole property. The roads were well built, and for a time prosperous, but since the war have fallen into difficulties, and the state has attempted to scale and repudiate its indebtedness for them.

The state of Missouri had done little toward the construction of roads until the session of 1851, when it was agreed to lend its aid to two great lines; the Pacific road, commencing at St. Louis and running across the state, on the south side of the Missouri river, and the Hannibal and St. Joseph road, extending 206 miles across the state from river to river, connecting the two cities named. This last had also a land grant of 600,000 acres, made the basis for $5,000,000 of the company's bonds. The state subsequently enlarged its plan, and agreed to issue $24,000,000 of its bonds in aid of the railroads. The panic of 1857 and the war troubles prevented the payment of interest on these bonds, either by the railroads or the state, for some years. In 1867, the state resumed payment and the railroads began a new career of prosperity. The most important roads are the Hannibal and St. Joseph, and branches, 292 miles long; the Pacific of Missouri, 421.6 miles long; the St. Louis and San Francisco, 392.4 miles in length; the St. Louis, Iron Mountain and Southern, 684 miles in length, and the Kansas City, St. Joseph, &c., 254 miles in length. The state has 3,998 miles of completed road, and 450 more in progress. Over $133,121,871 was expended on these roads up to Jan., 1880. The Pacific road had cost $16,595,048, of which $15,123,000 was bonded debt. The great railroad bridge over the Mississippi at St. Louis has materially benefited the railroad lines.

The Michigan Central reached the lake in May, 1849, and was also pushed to completion, going round the foot of Lake Michigan, where the Illinois Central put out a hand to meet it. The connection is thus 284 miles, Detroit to Chicago. The cost of this road was $15,951,936. The road was laid with T rail, and was very prosperous. The capital of the company is $11,197,348, and the debt $5,153,489. The road is an important link in the line of connection between Boston and the western country.

The state of Tennessee has an important system of railroads extending to all sections of the state. The state guarantees $8,000 per mile for the purchase of iron and equipment, upon the condition that the companies prepare the road-bed and defray the charges of construction. The state retains a lien upon the whole property. The roads have been well built.

The state of Missouri had done little toward the construction of roads until the session of 1851, when it agreed to lend its aid to two great lines; the Pacific road, commencing at St. Louis and running across the state, on the south side of the Missouri river, and the Hannibal and St. Joseph road, extending 206 miles across the state from river to river, connecting the two cities named. This last had also a land grant of 600,000 acres, made the basis for $5,000,000 of the company's bonds. The state subsequently enlarged its plan, and agreed to issue $24,000,000 of its bonds in aid of the railroads. The panic of 1857 and the war troubles prevented the payment of interest on these bonds, either by the railroads or the state, for some years. In 1867, the state resumed payment and the railroads began a new career of prosperity. The most important roads are the Hannibal and St. Joseph, and branches, 278 miles long; the Pacific of Missouri, 283 miles long, and the Southwest Pacific, 327 miles in length. The state has 1,827 miles of completed road, and 1,450 more in progress. Over $88,000,000 have been expended on these roads thus far. The Pacific road has cost $13,906,000, of which $7,550,375 is bonded debt. The great railroad bridge over the Mississippi at St. Louis will materially benefit the railroad lines.

## RAILWAYS OF THE WORLD, Jan. 1, 1877.

| Continent and Country. | Area. | Population. | Miles of R'y in operat'n. |
|---|---|---|---|
| NORTH AMERICA. | Sq. miles. | | |
| United States of America,* | 3,580,242 | 50,152,866 | 94,622 |
| Dominion of Canada, 1877, | 3,483,952 | 5,169,789 | 5,219 |
| United States of Mexico,. | 829,916 | 8,133,719 | 378 |
| Total North America,.. | 7,894,110 | 63,456,374 | 100,219 |
| CENTRAL AMERICA and WEST INDIES. | | | |
| Honduras, | 47,090 | 351,800 | 66 |
| Costa Rica, | 26,040 | 165,000 | 29 |
| Colombia (Panama), | 27,346 | 226,000 | 49 |
| Cuba, | 48,489 | 1,370,211 | 459 |
| Porto Rico, | 3,865 | 452,916 | 21 |
| Jamaica, | 6,400 | 401,317 | 34 |
| Barbadoes, | 166 | 31,719 | 6 |
| Total C. A. and W. I.,.. | 159,396 | 2,998,963 | 664 |
| SOUTH AMERICA. | | | |
| Colombia, | 320,750 | 2,851,858 | 43 |
| Venezuela, | 403,276 | 1,784,194 | 39 |
| Guiana (British),.. | 76,000 | 152,700 | 68 |
| Brazil, | 3,288,000 | 10,196,328 | 1,357 |
| Paraguay, | 56,700 | 300,000 | 47 |
| Uruguay, | 73,538 | 440,000 | 231 |
| Argentine Republic, | 838,600 | 1,877,500 | 1,466 |
| Peru, | 503,380 | 3,374,000 | 1,238 |
| Bolivia, | 473,560 | 1,600,000 | 38 |
| Chili, | 126,060 | 2,300,000 | 691 |
| Total South America,.. | 6,159,864 | 24,876,580 | 5,218 |
| EUROPE. | | | |
| Great Britain and Ireland, | 121,115 | 33,895,023 | 16,872 |
| France, | 204,096 | 36,905,788 | 12,722 |
| Spain, | 182,713 | 16,681,719 | 4,112 |
| Portugal, | 35,812 | 4,367,882 | 902 |
| Italy, | 114,406 | 27,769,465 | 5,028 |
| Switzerland, | 15,091 | 2,776,035 | 1,211 |
| Austria-Hungary, | 240,940 | 37,739,407 | 10,954 |
| Germany, | 208,344 | 42,727,260 | 18,229 |
| Belgium, | 11,372 | 5,253,821 | 2,278 |
| Holland and Luxembourg, | 13,670 | 3,940,024 | 1,260 |
| Denmark, | 15,218 | 2,013,257 | 893 |
| Sweden and Norway, | 293,328 | 6,303,395 | 2,966 |
| Russia, | 2,261,657 | 78,281,447 | 13,702 |
| Roumania, | 49,262 | 3,621,749 | 891 |
| Turkey, | 138,264 | 8,315,000 | 997 |
| Greece, | 19,353 | 1,461,201 | 7 |
| Total Europe, | 3,924,641 | 312,052 493 | 93,024 |
| ASIA. | | | |
| Turkey (Asia Minor), | 660,870 | 16,050,000 | 279 |
| India (British), | 909,834 | 191,065,445 | 7,152 |
| Ceylon, | 24,454 | 2,401,066 | 209 |
| Philippine Islands, | 120,000 | 5,000,000 | 279 |
| Java, | 51,336 | 18,125 269 | 296 |
| China, | 1,534,953 | 405 213,152 | 10 |
| Japan, | 156,604 | 32,794,897 | 41 |
| Total Asia | 3,458,051 | 670,649,829 | 8,266 |
| AFRICA. | | | |
| Egypt, | 606,340 | 6 252,000 | 1,013 |
| Tunis, | 42,500 | 2,000,000 | 92 |
| Algeria, | 258,306 | 2,416,225 | 401 |
| Cape Colony, | 181, 92 | 496,381 | 136 |
| Mauritius, | 708 | 316 042 | 66 |
| Total Africa, | 1,089,446 | 11,480,648 | 1,708 |
| AUSTRALASIA. | | | |
| Victoria, | 88,198 | 849,021 | 697 |
| New South Wales, | 323,437 | 618,214 | 501 |
| Queensland, | 669,520 | 173,283 | 452 |
| South Australia, | 383,328 | 218,060 | 301 |
| Western Australia, | 978,000 | 27,321 | 69 |
| Tasmania, | 26,215 | 105,484 | 45 |
| New Zealand, | 102,000 | 399,075 | 412 |
| Tahiti, | 2,000 | 10,000 | 21 |
| Total Australasia, | 2,572,698 | 2,400,458 | 2,498 |

## RECAPITULATION.

| | | | |
|---|---|---|---|
| North America, | 7,894,110 | 63,456,374 | 100,219 |
| Cen. Am. and W. Indies., | 159,396 | 2,998,963 | 664 |
| South America, | 6,159,864 | 24,876,580 | 5,218 |
| Europe, | 3,924,641 | 312,052,493 | 93,024 |
| Asia, | 3,458,051 | 670,649,829 | 8,266 |
| Africa, | 1,089,446 | 11,480,648 | 1,708 |
| Australasia, | 2,572,698 | 2,400,458 | 2,498 |
| RAILROADS of the WORLD, | 25,258,206 | 1,087,915,345 | 210,596 |
| Countries wholly without Railroads, | 26,077,304 | 401,719,205 | |
| The WORLD with Railroads and without, | 1,335,510 | 1,489,634,550 | 210,596 |

## STATEMENT

Showing the amount an character of the various classes of the Public Debt of the United States as existing on the 30th day June, 1881.

### Interest bearing Debt.

| | |
|---|---|
| Bonds at 6 per cent.,* | $196,378,000 |
| Bonds at 5 per cent.,* | 439,841,350 |
| Bonds at 4½ per cent., | 250,000,000 |
| Bonds at 4 per cent., | 738,659,000 |
| Refunding Certificates, | 688,500 |
| Navy Pension Fund, | 14,000,000 |
| Principal, | $1,639,567,750 |
| Interest, | 20,223,225 |

### Debt on which Interest has ceased since Maturity.

| | |
|---|---|
| Principal, | $6,723,865 |
| Interest, | 718,686 |

### Debt bearing no Interest.

| | |
|---|---|
| Old Demand Legal-Tender Notes, | $346,741,551 |
| Certificates of Deposit, | 11,925,000 |
| Fractional Currency,† | 7,105,9[illegible]3 |
| Gold and Silver Certificates, | 56,949,450 |
| Principal, | $422,721,954 |
| Unclaimed Pacific Railroad Interest, | 6,746 |
| Amount of Fractional Currency estimated as lost or destroyed,† | 8,375,934 |

### Total Debt.

| | |
|---|---|
| Principal, | $2,069,013,569 |
| Interest, | 20,948,658 |
| Total, | $2,089,962,227 |

### Cash in the Treasury.

| | |
|---|---|
| Available Assets, | $249,363,415 |
| Debt less Cash in the Treasury, | 1,840,598,812 |

### Bonds issued to the Pacific Railroad Companies, interest payable in lawful money.

| | |
|---|---|
| Principal outstanding, | $64,623,512 |
| Interest accrued and not yet paid, | 1,938,705 |
| Interest paid by the United States, | 49,528,566 |
| Interest repaid by transportation of Mails... | 14,426,126 |
| By Cash Payments, 5 per cent. Net Earnings, | 655,199 |
| Balance of Interest paid by United States,. | 34,447,241 |

* These 6 per cent. and 5 per cent. bonds were due this year. Almost 95 millions of them will be paid in August and September, and the remainder, $576,881,800, has been extended by the plan of Secretary Windom at 3½ per ct.; these bonds are payable at the pleasure of the Government. On the 1st of October, 1881, the interest-bearing bonds will stand as follows:

| | |
|---|---|
| Four and a half per cents., | $250,000,000 |
| Four per cents | 739,347,800 |
| Three and a half per cents, | 576,881,800 |
| Total, | $1,566,229,600 |
| Navy Pension Fund, | 14,000,000 |
| Total, | $1,580,229,600 |
| The debt bearing no interest will probably be about | 422,000,000 |
| | $2,002,229,600 |
| Less probably more than of cash in the Treasury, | 200,000,000 |

So that we may reasonably expect the debt on the 1st of October to be below 1,800 millions.

The Annual Interest March 1, 1881, was....$76,845,937.50
The Annual Interest Oct. 1, 1881, will be ... 61,434,775.00

**Making an annual saving of interest of.....$15,411,164.50**

The earliest of the larger railroads in the East had, for the utmost limit of their ambition, at first, the idea of reaching Lake Erie, the Ohio River, or in the Southern Atlantic States the Alleghany range. It was a long time before they attained these points—and meantime, though other roads, some of them built, it is true, with eastern capital, had stretched across the prairies to Chicago and St. Louis, they were run in connection with the Eastern roads, but apparently without any thought of consolidation. In 1850, twenty miles of railroad, extending from Chicago toward Milwaukee were built, but there was not a mile of railroad then or till five years later beyond the Mississippi except 38 miles along the west bank of that river from St. Louis northward. In 1860 Wisconsin had 905 miles of railroad extending northward, northwestward, and westward from the lake. Iowa and Missouri had begun to build railways westward to the Missouri river, the former having 655 miles built but only a part of it in operation that year, and the latter 817 miles built but not more than 500 miles in operation. Not much progress was made in these two states till the close of the war, and there was none elsewhere beyond the Mississippi. In July, 1862, in the midst of the great civil war, the feeling which had led to the sending out of several exploring expeditions to find a practicable railroad to bind California and the Pacific states and territories more closely to the Union, culminated in an act of Congress chartering the Pacific railroad. There were some defects in the charter and no company was formed till October, 1863, when the Union Pacific and soon after the Central Pacific was organized. By the charter the capital stock of the entire route was to be $100,000,000, and the government granted them a roadway of 200 feet on each side of the track, and alternate sections of land for twenty miles on each side of the road; and in addition its bonds, maturing in 30 years, bearing six per cent. payable in gold, for $16,000 per mile for the plain, $32,000 per mile for the steeper grades, and $48,000 per mile for the deep cuttings and tunneling. They were, moreover, authorized to issue their own bonds to an equal amount with these government bonds, at the same rate, and these lands were to be a first mortgage (the government bonds being a second mortgage) on the road. With these ample resources the two companies began at their respective ends to build the road in 1865; the Union Pacific commencing at Omaha, Nebraska, and the Central Pacific, at Sacramento, California. The Central Pacific built 742 miles, much of it through the mountains, and the Union Pacific 1,032 miles. The junction of the two roads was effected May 15, 1869, and regular daily passenger trains were run each way, as well as numerous freight trains. Since that date the two roads have built several branches—the Union Pacific in Nebraska, Wyoming, and Colorado, and has obtained the control of the Kansas Pacific and Central branch of the Union Pacific and the Central Pacific of the Utah and Northern and Utah Southern, several short lines in Nevada, the Western, Oregon and Pacific, and Southern Pacific, and some of the Pacific coast lines. The mileage of the Union Pacific Jan. 1, 1880, aside from branches, was 1,042.4 miles; and of the Central Pacific at the same date, including some of its branches, 1,213.1 miles. Both roads have greatly extended their mileage since that date. It is difficult to say exactly what has been the cost of these two roads. They were built under great difficulties at a time when everything was high and when men who took great risks expected to be well paid for it; it was moreover a time of gigantic frauds, and it is more than suspected that these two roads had their share of them. The *Credit Mobilier* and other speculations were a disgrace to the nation and especially to those men in high station who participated in them. The reports of these roads for the year ending Jan. 1, 1880, give the following figures:

| | |
|---|---|
| Union Pacific, cost of road and equipments. | $114,493,812 |
| Central Pacific and branches, cost of road and equipments | 153,285,531 |
| Together | $267,779,343 |

This is far too much; but the roads were needed, and are now honestly managed. The Government loans to them have been to June 30, 1881, about $63,000,000 of principal, and $36,300,000 unpaid interest. Both roads are doing well. The gross earnings of the Union Pacific in the calendar year 1879, were $13,201,077; of the Central Pacific, for the same year, $17,153,163. The latter has now, in its Southern Pacific road, owned by the Central Pacific, recrossed the continent and provided a second Trans-Continental road, not only to Galveston and other Gulf ports, but through its connections to the Mississippi river and the Atlantic. The rapid construction of the Union and Central Pacific railroads led to three great results: 1. The closer union and eventual consolidation of the eastern lines with the roads leading to Chicago and St. Louis. 2. The construction and consolidation of roads from those cities to points further west, and in the first instance to a concentration of different routes from those cities and others of the Mississippi Valley upon Omaha and Council Bluffs, and a little later upon St. Joseph and Kansas City, which also became termini of the Union and Kansas Pacific; and 3, to the projection and speedy construction of other lines to the Pacific Coast.

Let us take up these results in their order. The great trunk roads of the eastern states in 1869 were: 1. The Portland and Boston lines, which, while maintaining a *quasi*-connection with the New York Central and the Lake Shore, had also a more northern and somewhat shorter route by the Portland and Ogdensburgh, the Grand Trunk, Rome, Watertown and Ogdensburgh, Great Western, and Canada Southern to Detroit and thence by the Michigan Central to Chicago. These lines are mostly owned and controlled now in Boston. 2. The N. Y. Central and Hudson River, which had also its choice of two routes, viz., by Niagara Falls to the Canada Southern and Michigan Central, and by Buffalo, the Lake Shore and Michigan Southern road to Chicago. Circumstances led it to prefer the latter, and the Lake Shore road is now virtually owned by the New York Central. 3. The Erie (now N. Y. Lake Erie and Western) which traversing New York by several routes had two lines of connection with Cincinnati, Chicago and St. Louis, viz., by the Atlantic and Great Western either to Cleveland and Toledo, and thence by other roads or by the same road to Dayton and thence to Cincinnati, or to Indianapolis and St. Louis, and by Hornellsville and Buffalo, and by Dunkirk, and by rail or steamer, thence to Cleveland or Cincinnati. The Erie railway makes close connections with these roads, but we believe does not own all of them. 4. The Pennsylvania road, which very early acquired the exclusive control of the Pittsburgh, Fort Wayne and Chicago, and now owns it. This railway has also control of other lines from Fort Wayne to St. Louis. 5. The Baltimore and Ohio, which has built and owns a very direct line to Chicago, and through the Mississippi and Ohio and other roads which it controls has a very direct and short route to Cincinnati and St. Louis.

Two other roads are now nearly prepared to enter the lists with those already mentioned as trunk lines; viz., the Chesapeake and Ohio, already mentioned, which having its eastern terminus at Norfolk has nearly completed its lines to Cincinnati and Louisville, from which points there will be ready and close communication with both Chicago and St. Louis; and the new routes now constructing *via* the N. J. Central, and Delaware, Lackawana and Western, from Binghamton to Buffalo, and that on the west side of the Hudson and parallel with the N. Y. Central to the same point to be connected with Boston on the east and with Jay Gould's Wabash system on the west.

The second result to be noticed was the consolidation and concentration of different routes from Chicago, St. Louis and other cities of the Mississippi Valley upon points farther west, and primarily upon Council Bluffs or Omaha, and a little later upon St. Joseph and Kansas City, all three being in some sense eastern termini of the Union Pacific railroad. Some of these consolidations are gigantic in their extent. The "Chicago and Northwestern" railway owns and operates more miles of railroad than the Union and Central Pacific combined. In March, 1881, it had 2,974.5 miles of its own road in operation, and was building with great rapidity 445 miles more. It has now (August, 1881,) over 3,000 miles in operation besides leased lines. Its business is enormous. Its railway lines cost in May, 1880, over $82,000,-000. They have almost doubled since. Its gross earnings for the year ending May 31, 1880, were $17,349,349. They have greatly increased within the past year; moreover, it pays a six per cent. dividend which is more than some of those gigantic concerns are able to do.

Two of its rivals are nearly equal to the Chicago and Northwestern in the extent and magnitude of their operations; the Chicago, Milwaukee and St. Paul had, Jan. 1, 1880, 2,231 miles of railway which it owned and operated, and has since largely increased the number. The cost of its lines and equipment, at that time, was $72,748,873; its gross earnings were $10,012,820 for the year 1879. It makes a dividend of 7 per cent. on its preferred stock. The Chicago, Burlington and Quincy railway had, Jan. 1, 1880, 1,857.3 miles of its own track, and partly owned railroads having over 600 miles more. This road (the C., B. & Q. of the stock market a few years ago), cost, with its equipment, $78,361,721. Its gross earnings for the year 1879 were $14,817,105, and it pays an 8 per cent. dividend. Another of these gigantic combinations is the "Wabash," whose present title is, we believe, "The Wabash, St. Louis and Pacific." A year and a half ago it had 1,302 miles of track which it owned and operated; its cost was reckoned at $75,000,000. Its extent and cost, its stocks and bonds, and its gross earnings, to-day, no man knoweth, not even Jay Gould. It may yet absorb half the railway property on the continent, and having overrun Mexico as well as the United States, may fling a suspension bridge to the Sandwich Islands or even to Australia. Who knows?

The third result we proposed to notice was the projection and construction of other railways to the Pacific Coast. The Northern Pacific was projected before the completion of the Union and Central Pacific, and made good progress until 1873, when it went down in the financial disaster of that year. In 1878 it began to recover and had fully regained its position in 1880. It has been constructing its road from both ends with great rapidity, and a syndicate of bankers took its bonds to the extent of $50,000,000 to secure its completion, in the winter of 1880–81. In May or June, 1881, it passed into the control of the Oregon Railway and Navigation Company, a wealthy and powerful corporation who owned the steamship lines between San Francisco and the ports of Oregon and Washington Territory, and who were already constructing railway lines along the Columbia river and at other points. The 1,004 miles already completed in June, 1881, cost, for road and equipment, about $120,000,000, and were represented by $91,312.588 capital stock, $21,586,800 of bonded and $1,446,038 of floating debt. The railway is rich in valuable lands. Its earnings in its unfinished state are, of course, not large, $2,994,519 in 1880–81; but they will be much larger now, and when completed the road cannot fail of becoming excellent property.

The Missouri Pacific, with which the Kansas Pacific has recently been consolidated, extends from St. Louis to Denver, Colorado, but will probably eventually go west to the Pacific Coast in connection with some of the Colorado roads—possibly the Denver and Rio Grande. Its line to Denver is very direct.

The Atchison, Topeka and Santa Fé railway is one of the most remarkable railway enterprises of our time. It had a considerable land grant in Kansas, but at a time when most railway enterprises were at a stand still, its stockholders and managers, most of them Boston men, moved forward directly into the desert, with no considerable town in prospect till they should reach Santa Fé, a thousand miles away. Population followed them and their lands sold well. In Colorado they found a fast increasing population, but they turned southward and having reached Santa Fé, they started for the Pacific. They propose to reach the Ocean by several different routes. One branch has reached El Paso and will perhaps be continued to the City of Mexico, or possibly reach the Gulf of Mexico through Texas. Another has already reached Tucson, Arizona, and is going to Guaymas, Mexico, on the Gulf of California. At Tucson the railway connects at present with the Southern Pacific and conveys passengers to Southern California to Los Angeles, or for that matter to San Francisco. Still another branch strikes due west from Santa Fé under the charter of the old Atlantic and Pacific railway, crosses Arizona a little north of the 35th parallel, and spanning the Colorado river by a bridge 400 feet above the stream, will strike the Pacific coast probably at Santa Barbara. The railway will probably complete 1,200 miles of railway in the two years 1880–1882. The Texas Pacific after a long and hard fought struggle will probably unite with the Southern Pacific at or near El Paso, and thus reach the Pacific coast.

There are yet other proposed railways to the Pacific coast, two or three of them traversing Mexico—and the Denver and Rio Grande and the St. Louis and San Francisco may eventually find their way thither. That there is danger in multiplying too rapidly these expensive investments where there is no local traffic to support them is evident. Within the last two years more than two thousand millions of dollars, a sum larger than our national debt has been locked up permanently in road bed, timbers, track, and buildings and equipments, for railroads, mostly in the extreme west. We are a young nation to stand such an enormous drain. It is true that nearly 750 millions of it is European capital; but when capitalists abroad find, as many of them will, that these investments yield no dividend, they will be bitterly disappointed and hostile to us as a nation; and meantime our own losses will be greater than we can endure.

Within the past four or five years, and still more strikingly since 1879, there have been attempted, and partly, at least, consummated the most gigantic railway combinations known to human history. Men of unbounded ambition and audacity have sought, not only to control and consolidate routes across the continent, a distance of perhaps 3,000 miles, or, with the feeders which pour traffic into them, of perhaps 6,000 or 8,000 miles, but have engaged in a strife with each other for the control under a single leadership of all the routes to the Pacific, and the steamship lines with which they are connected. At the present time, of the ten or eleven routes to the Pacific, completed or in progress, (including the Canadian Pacific and three or four traversing the Republic of Mexico,) one man—Jay Gould—virtually controls five, and makes his power felt on all the subsidiary and ancillary lines connected with them. Another man has just obtained the control of one, and that one destined to be the most powerful of the whole. Another, a Californian railway king, controls two and possibly three; while Boston capital, in the person of one of its most enterprizing citizens, owns and energizes a railway which, erelong, will touch the Pacific at five or six points, and probably the Gulf of Mexico at one or two. If human life were longer and human vigor and energy capable of being extended into a second century of existence, we might be warranted in expecting that some Napoleon or Alexander of the railway would succeed in bringing under his control not only the 100,000 miles of completed railway, but all that is projected on our continent, and wielding the 7,000 or 8,000 millions which are represented in its construction and equipment, make himself the owner and controller of our Congresses, the Dictator to our Presidents, the absolute autocrat of all the nationalities which inhabit the new world. Such things might be, had not God in his mercy put a limit now, as in the time of the deluge, to individual human activities.

Still, among the potencies for evil, which are within the reach of these railway potentates, is a joining of their forces, and a combination of their capacities for oppression in one gigantic, colossal association, a monopoly such as had never before been dreamed of, but one which could make its power felt, and felt oppressively, by every inhabitant of our land. Not only would all commerce and all travel be at its mercy, but the grain, the flour, the provisions we consume, the raw material of the clothing we wear, whether of cotton, linen, wool or silk, and the manufactures of these as well, the gold and silver, the copper, lead, zinc and iron, which enter into all the business of life; all we eat, drink, or wear, all our books and newspapers, all our public and private edifices, and worse still, all our legislation would be at the mercy, and by the grace of this vast monopoly, with which there could be no hope of competition, and from which there could be no escape. The rich and poor alike would be its slaves, and writhe as they might, under its iron grasp, their fate would be as inexorable as the forces of nature. From such a monopoly, there may be now a way of escape. Twenty years hence there will not be. The peril is imminent, the danger is real, and should be considered by every wise and thoughtful man, ere it is too late.

We have not included in this brief *resumé* of the railroads of the country the following classes: 1st. Those extensive lines now in course of construction in Mexico, by American companies and with American capital; there are nearly 6,000 miles of these now in progress, mostly narrow gauge roads, but it is impossible at present to form any estimate of their cost or mileage, or of their prospects of success. 2. The city or horse railroads. These are now in operation in every city or large town in the United States, but we have found it utterly impossible to obtain any satisfactory recent reports in regard to them. Those of the State of New York exceed one hundred in number, and their stock and funded and floating debts amount to over $60,000,000. A very moderate estimate of the stock and debts of all these roads in the country would be $250,000,000. 3. The elevated and rapid transit railways. But a very few of these are yet in operation; but these few have been financially successful and are but the precursors of many more. There may be $50,000,000 or $60,000,000 invested in them up to Aug., 1881. But leaving these three classes of railroads out of the account altogether, the expenditure of $5,450,795,963 for railways and their equipment in the short space of fifty years, and more than half of it within the last ten—a sum equal to the united public debts of Great Britain and the United States at the present time, and one whose vastness exceeds our power of computation—is a fact without a precedent in the world's financial history. That some of these roads are not worth, to-day, half what they cost, is probably true; but even the poorest of them has much more than paid for itself in bringing the products of agriculture and manufactures to market at rates far below those which were necessary when there were no means of transit except by poor wagon or country roads, or trails which could only be traversed by pack-horses or mules. The usual price for carrying grain to market by wagon was 40 cents a ton per mile traveled. (They charge a higher rate than that, over the rough wagon roads of Colorado, now.) At that rate, when the price of Indian corn was 75 cents at the nearest market, 125 miles distant, the farmer was obliged to pay 50 cents a bushel to the teamster, and from ten to fifteen cents a bushel for charges for handling and commissions. The bushel of corn brought him from ten to fifteen cents, not nearly enough to pay the cost of cultivation. At a distance exceeding 125 miles, he could not afford to send it to market, and must either feed it, (though with almost the same difficulty in regard to his swine and cattle) or burn it in the place of coal. Wheat, which, in favorable years, if of the best quality, brought $1.50 per bushel, could be transported 250 miles and leave him from 22 to 25 cents a bushel for his wheat. How is it now? The farmer in Northern Montana and Dakota can send his wheat four hundred miles to the steamer at Duluth, on Lake Superior, for fifteen cents a bushel, or 750 miles to Chicago or Milwaukee for thirteen cents, or to New York, 1,500 miles, for 35 cents, or a barrel of flour for 75 cents, and though the price of the wheat is now not more than $1.25 to $1.35 in New York, it nets him 90 cents to a dollar a bushel 1,500 miles away. The same proportion exists with regard to other grains, provisions, mining products, &c., &c., and thus the railroad accomplishes three beneficent results; it enables the merchant to draw his supplies from a much larger area than was possible with wagon roads only; it cheapens the price of food products by competition, yet it enables the producer to receive a better remuneration for his labor.

The railroads of the country may be generally classified, as to their freight, under four heads: coal roads, that is, those which bring principally coal to the sea board, taking miscellaneous freight on their return westward; cotton roads, mostly in the south, whose principal outward bound freight is cotton; grain or, as they are sometimes called, granger roads, which carry eastward grain, farm products, provisions, and live cattle and sheep, and return laden with manufactured goods, machinery, &c., &c., and mining roads, which bring ores, iron, zinc, lead, copper, and the precious metals and their ores eastward for reduction or manufacture.

The principal coal roads in the east are the Philadelphia and Reading, the Schuylkill Canal, Lehigh Valley, Delaware, Lackawanna and Western, Shamokin Valley, Central New Jersey, United R. R. of New Jersey, Pennsylvania coal, Delaware and Hudson Canal R. R., Huntington and Broad Top Mountain, Pennsylvania, and Clearfield, Pa. These roads have capital, stocks and bonds to the amount of over 450 million dollars—and transport annually about 45 million tons of coal. The Baltimore and Ohio Railway, the Chesapeake and Ohio, and many of the Ohio, Indiana, Illinois, Kentucky, Missouri, and Iowa roads are also to a great extent coal roads. The entire amount of coal marketed in 1880 was 69,200,934 tons of 2,240 pounds each. The following table shows the rapid increase in the production and demand for coal in the past 60 years, and especially in the last decade:

| | *Tons.* |
|---|---|
| Coal of all descriptions sent to market from 1820 to 1830, | 636,903 |
| From 1830 to 1840, | 5,377,540 |
| From 1840 to 1850, | 15,094,132 |
| From 1850 to 1860, | 46,139,090 |
| From 1860 to 1870, | 161,050,916 |
| From 1870 to 1880, | 502,460,000 |
| Total, | 730,759,256 |

The production of the last decade was considerably more than double that of the whole previous fifty years. During most of the last decade the prices of coal have ruled low, though in the early part of it and previously they were high enough. Perhaps for the whole sixty years $4 per ton as the price at the receiving ports would not be more than the average rate. This would make the value of the coal production of the sixty years $2,923,037,024.

So large a portion of the cotton produced is partly or wholly transported by water carriage, that it is not possible to give with any approach to accuracy the amount carried by railroads in any given year. The following table is, however, of interest as showing the relation of the multiplication of railroads to the increase of the cotton crop during the last forty years. The number of miles of road was that in operation each year in the ten principal cotton states:

| | Miles of Road. | Cotton Crops, Bales. |
|---|---|---|
| 1841, | 662 | 1,634,945 |
| 1842, | 791 | 1,683,574 |
| 1843, | 848 | 2,378,875 |
| 1844, | 932 | 2,030,401 |
| 1845, | 1,109 | 2,394,503 |
| 1846, | 1,169 | 2,100,537 |
| 1847, | 1,303 | 1,778,651 |
| 1848, | 1,319 | 2,347,634 |
| 1849, | 1,415 | 2,728,596 |
| 1850, | 1,415 | 2,096,706 |
| 1851, | 1,560 | 2,355,257 |
| 1852, | 2,010 | 3,015,029 |
| 1853, | 2,515 | 3,262,882 |
| 1854, | 3,040 | 2,930,027 |
| 1855, | 3,362 | 2,847,339 |
| 1856, | 3,809 | 3,527,845 |
| 1857, | 4,165 | 2,939,519 |
| 1858, | 4,751 | 3,113,962 |
| 1859, | 5,552 | 3,851,481 |
| 1860, | 5,914 | 4,675,770 |
| 1861–70, | 9,693 | 16,301,063 |
| 1871, | 10,833 | 4,352,317 |
| 1872, | 11,309 | 2,974,351 |
| 1873, | 12,460 | 3,930,508 |
| 1874, | 12,638 | 4,170,388 |
| 1875, | 12,778 | 3,832,991 |
| 1876, | 13,335 | 4,669,288 |
| 1877, | 13,645 | 4,485,423 |
| 1878, | 14,136 | 4,811,265 |
| 1879, | 14,685 | 5,073,531 |
| 1880, | 15,720 | 5,761,252 |
| Totals, | 15,720 | 149,465,910 |

The cost of these 15,720 miles of railroad did not probably exceed 786 million dollars; while the value of the cotton transported for greater or less distances on the railroads, and much of which could not probably have been brought to market except at a loss had not these railroads been built—was, reckoning the price at $50 per bale, which is a low average for the 40 years—$7,473,295,500, or nearly ten times the cost of the railroads.

So large a portion of our grain and provision products are transported by water that it is not easy to make any estimate or comparison between the cost of the grain or granger roads and the amount of these products which they transport. And yet, when we consider the great number of the roads, and the number and length of the trains, and know that when the greater part of the grain crop is coming into the markets, every depot and warehouse is filled almost to bursting with the grain and flour, and notwithstanding the utmost efforts of the railroad trains to reduce the quantity by the shipment of long and heavily laden extra trains, these receptacles continue to be filled to overflowing for many months, we shall find that the magnitude of their business is even greater than that of the coal or cotton roads.

The influence of these roads in developing the agriculture of the new states and territories is great, almost beyond belief. Of the 1,773 million bushels of Indian corn, the 460 million bushels of wheat, the 407 million bushels of oats, and the other cereals produced in 1880, it is within bounds to say that not one fourth would have been grown had not the railroads pushed their way everywhere, often in advance of the population, and in order to induce settlement, had furnished the people from the first crop with such cheap and easy transportation, thus bringing the market to their very doors. It is not yet twenty-five years since on the prairies of eastern Kansas and Nebraska, corn was worth so much less than ten cents a bushel that it could not be sent to market, and after the swine had consumed all they could the residue was burned instead of coal as being much the cheaper fuel. In western Kansas and Nebraska, where railroad transportation is not so easy, corn is still low, worth from 18 to 25 cts. a bushel, but at this price it pays when used for fattening swine. The advance in its price to 25, 35, and 40 cents a bushel is due wholly to the facilities of transportation furnished by the railroads. The same thing is true to a still greater extent of the live stock and provision trade. For centuries the boast of England has been,

> "The roast beef of Old England,
> And the Old English roast beef."

But our vast pasture grounds of the most succulent and nutritious grasses, and the low price of grain has enabled us to put live steers on the Liverpool and Glasgow markets, well fatted, weighing from 1,600 to 1,800 pounds for $100 and make a handsome profit on them. The quality of the beef is equal if not superior to any in their markets, and the price altogether below what is the cost of production of similar animals there. We have sent also to them in refrigerator steamers immense quantities of fresh beef and other meats of excellent quality and at low prices, and provisions in the ordinary meaning of the word, mess pork, mess beef, hams, bacon, canned meats, lard, butter, cheese, etc., at such prices as have almost annihilated farming there, and this very year (1881) many thousands of English, Scotch, and Irish farmers are emigrating to this country to raise grain and keep live stock where these products can be raised at a profit and not at a loss.

There are now many centers of this grain and provision trade; foremost among them is Chicago, but St. Louis, Milwaukee, Minneapolis, St. Paul, Detroit, Toledo, Cleveland, Dubuque, Davenport, Peoria, and farther south, Cincinnati, Louisville, Indianapolis, and in New York, Buffalo, Rochester, and Oswego are also largely engaged in the business. Milwaukee contests with Chicago the supremacy in the grain trade.

The growth of this business in Chicago is shown comparatively, so far as railroad traffic is concerned. In 1860 the entire gross earnings of the railroads centering at Chicago were $15,297,155 ; in 1868, they were $73,952,838. In 1879, many of these roads had consolidated, so that the number of trunk roads centering in the city was less than in 1868, but they were connected through a wider territory and brought a larger tribute to the city, though Milwaukee and St. Louis had drawn off what they could, yet on the 31st of December, 1879, the gross earnings of the trunk railroads having their termini in Chicago (not counting the smaller roads) was $120,656,185, eight times as much as it was nineteen years before.

The mining or mineral roads have increased in their business perhaps more rapidly than any others. They have to a very large extent penetrated into regions heretofore wholly uninhabited, and in many cases the miner has only preceded them by a few weeks or months, and sometimes has actually followed their trail. The Atchison, Topeka and Santa Fé, the Denver and Rio Grande, and the Denver, South Park and Pacific have been the most adventurous roads in this pioneer work, though the Union and Central Pacific, the Southern Pacific, the Western Pacific, the Utah and Northern, the Utah Central, the Utah Southern, The Northern Pacific, in its Rocky Mountain and Yellowstone Divisions, and some of the Oregon and California, and Oregon Railway and Navigation Company's lines, the Northwestern and the Chicago, Milwaukee and St. Paul in their lines penetrating across Dakota to the Black Hills, have engaged in it with great zeal. Most of these lines are so recently constructed, and the country they have opened is so new that it is yet too soon to give any definite statistics of their business, but they are already finding ample employment in transporting refractory ores of gold, silver, copper, zinc, and rarer metals to the reduction works, and iron and coal from those western mines to all sections of the west, and their return freights of timber, lumber, machinery, provisions, dry goods, and miners' tools, are equally heavy.

The expenditure of this vast sum for railways within a period of little more than forty years, and more than half of it within the last ten—an expenditure amounting to over one hundred dollars for each inhabitant of the average population of the United States, during that period—is without a precedent in the world's history. Had this been accomplished in a country as old and rich as England, and where capital had accumulated and was constantly seeking avenues of investment, it would still have been wonderful, but it has been done in a country whose whole valuation of real and personal estate in 1860 was, by the most liberal tables, only $16,-519,616,068, and less than half this was personal property, so that the cost of the railroads of the United States up to 1870, is about three-sevenths of the entire personal property of the United States in 1860. That there has been a vast increase in our national wealth within the past ten years, no one can doubt, and this increase undoubtedly makes the present valuation of personal property sixteen or seventeen thousand millions of dollars, but even this is only five or six times the cost of the railroads. That many of them are not worth to-day what they cost, perhaps not the half of it, is undoubtedly true, but, on the other hand, a considerable number are worth nearly double their cost, and will continue to increase in value.

We might be led to suppose, reasoning from analogy, that so great an absorption of capital in the construction and equipment of railroads would have rendered it scarce for other purposes; but, owing to the fact that the railroads in this country have for the most part been the pioneer influences in developing the settlement, and stimulating the production of crops, manufactures, and mining products, capital has not only not been rendered more scarce by their construction, but has been greatly increased, and is constantly becoming more plentiful. Prior to 1860, there were but seven railroads in the United States with a capital stock of ten million dollars or more, and not one with twenty millions; now there are fifty which have cost more than ten millions, and fifteen ranging between twenty and one hundred millions. Our railroad indebtedness, like our national bonds, is, much of it, held in Europe. The stock and bonds of the Boston and Albany, the Erie, Atlantic and Great Western, Lake Shore, Ohio and Mississippi, Illinois Central, Chicago and Northwestern, Kansas Pacific, Union Pacific, Central Pacific, the leading Southern roads, and some others, are very largely held in Europe, and some of them are entirely controlled by foreign influences. It is partly on this account that hitherto foreign and especially English rails have been so largely used for their construction, often to the very great detriment of the roads. From 1840 to 1857, 3,004,130 tons of rails were imported from Great Britain, at a cost of about $150,000,000, paid for, to a considerable extent, in railroad bonds, at prices considerably below par. From 1857 to 1869, (both inclusive,) 1,717,222 tons more were imported, at a cost of somewhat more than $75,000,000. Within a few years past, it has been found that steel rails possess great advantages over iron, and they are beginning to be extensively adopted, the great roads laying them as fast as they can without disturbing their traffic. Over 50,000 tons of these rails were laid in 1869, of which 35,000 tons were foreign, and between 15,000 and 16,000 tons American. It is estimated that not far from 90,000 tons will be laid in 1870, of which probably two-thirds will be American steel, the best qualities of which are worth from $100 to $120 per ton. The most important single article of freight transported by the railroads is coal; several very extensive railroads, particularly the Philadelphia and Reading, the Philadelphia and Erie, the Delaware and Lackawanna, the Lehigh Vallep, the Lehigh and Susquehanna, Lackawanna and Bloomsburg, the Morris and Essex, the New Jersey Central, and the Baltimore and Ohio, are almost wholly supported by this traffic, while many others do a very large coal business. The employment of coal as fuel, though known some years before, was not attempted to any great extent prior to 1820. The following table shows how greatly it has been developed since that time, and particularly within the past ten years. There has been, it will be noticed, an increase of more than three hundred per cent. in each successive decade. Though there will be no such increase in the future in the anthracite coal production, the bituminous and semi-bituminous coals will develop even more rapidly for many years to come.

| Coal of all descriptions sent to market | *Tons.* |
|---|---|
| from 1820 to 1830,....... ........ | 636,903 |
| From 1830 to 1840,................. | 5,377,540 |
| From 1840 to 1850,........ ........ | 15,094,132 |
| From 1850 to 1860,................. | 46,139,098 |
| From 1860 to 1870,.................. | 161,050,916 |
| Total tons,.................... | 228,299,256 |

This, at an average value of $5, gives $1,141,496,280. The investment in railroads and canals to transport to market the 18,308,316 tons of coal forwarded in 1869, is not less than $300,000,000. It is true that only about three-fourths of the traffic of these railroads and canals is coal, but nine-tenths of the remaining one-fourth has grown out of the coal development and transportation.

Under the supposition that the coal transported pays the interest on this investment, which is (at six per cent.) $18,000,000, then the 18,308,316 tons transported in 1869, at a value of $91,500,000, paid 98 cents per ton, or 19.5 per ct., thus making the clear value of the coal sent to market from those fields, $73,500,000. This includes the product of all the coal fields east of the Alleghanies, and also the coal products of the upper Ohio Valley.

It is estimated that there were 10,000,000 tons of bituminous and semi-anthracite coals sent to market from the Mississippi Valley and Rocky Mountain coal fields the same year. The annual sale of coal from all these fields is, in round numbers, $140,000,000, and this sum is added to the floating capital of the country as a consequence of the $450,000,000 invested in these railroads and canals. In other words, the cost of construction is repaid in three years nearly, and a perpetually increasing fund flows down for the promotion of trade, since coal is as much a purchasing power for goods as gold. What those roads have done for coal, have the southern roads done for cotton. Formerly the water-courses were the only means of transportation; and when they were dry or shallow, cotton accumulated at the landings until the next flood. The iron arms now stretch out in all directions, and not only is all the cotton grown added to the marketable value, but new lands are brought into action. The effect of railroads upon cotton is seen in the following table, which shows the miles of railroad open in ten cotton states, and the quantity of cotton produced:—

| | Miles of road. | Cotton crop. Bales. |
|---|---|---|
| 1841 | 662 | 1,634,945 |
| 1842 | 791 | 1,683,574 |
| 1843 | 848 | 2,378,875 |
| 1844 | 932 | 2,030,401 |
| 1845 | 1,109 | 2,394,503 |
| 1846 | 1,169 | 2,100,537 |
| 1847 | 1,303 | 1,778,651 |
| 1848 | 1,319 | 2,347,634 |
| 1849 | 1,415 | 2,728,596 |
| 1850 | 1,415 | 2,096,706 |
| Total | | 21,174,422 |

| | Miles of road. | Cotton crop. Bales. |
|---|---|---|
| 1851 | 1,560 | 2,355,257 |
| 1852 | 2,010 | 3,015,029 |
| 1853 | 2,515 | 3.262,882 |
| 1854 | 3,040 | 2,930,027 |
| 1855 | 3,362 | 2,847,339 |
| 1856 | 3,809 | 3,527,845 |
| 1857 | 4,165 | 2,939,519 |
| 1858 | 4,751 | 3,113,962 |
| 1859 | 5,552 | 3,851,481 |
| 1860 | 5,914 | 4,675,770 |
| | | 32,519,111 |

The value of the 5,914 miles of roads built was not far from $150,000,000, but the value of the cotton produced and brought to market was in the twenty years $2,900,000,000. The increase in the value during the last ten years over the former decade was $800,000,000. The war so far changed the current of affairs that the 10,000 miles of completed railways in the south are now, and will be for years to come, engaged in a more general but not less profitable traffic, in which, however, cotton and sugar will be very heavy items.

In the western country the results are still more marked, since a country which was a wilderness has, under the influence of railroads opening the way, become the source of immense wealth. This influence upon the grain business of Chicago is seen in the following table, which shows the number of miles in operation in Illinois and Wisconsin, in each year, and the bushels of grain received in Chicago for corresponding years:—

| | Miles of railroad. Illinois. | Miles of railroad. Wisconsin. | Grain receipts. Bushels. |
|---|---|---|---|
| 1841 | 22 | .. | 40,000 |
| 1852 | 148 | 20 | 5,873,141 |
| 1853 | 296 | 50 | 6.412,181 |
| 1854 | 1,200 | 200 | 12,932,320 |
| 1855 | 1,884 | 240 | 16,633,700 |
| 1856 | 2,241 | 285 | 21.583,221 |
| 1857 | 2,571 | 559 | 18,032,678 |
| 1858 | 2,678 | 793 | 20,035,166 |
| 1859 | 2,774 | 838 | 21,736,147 |
| 1860 | 2,811 | 951 | 40,000,000 |
| 1868 | 4,708 | 1,451 | 72,356,982 |

The cost of the Illinois and Wisconsin railroads (to which should be added 823 miles of Minnesota roads, as tributary to Chicago as the others,) to July, 1868, had been $305,778,265. Since its settlement the government has sold over 20 millions of acres of land in Illinois, and the canals, railroads and state, about 4 millions more. Aside from the large quantities of grain sent directly to St. Louis, New Orleans, Louisville, and Cincinnati, and the live stock shipments over these roads, the cut meats, butter, lard, and lumber, &c., &c., the grain receipts alone, in 1868, amounted to over 150 million dollars. The other receipts were certainly more than as much more, so that one year's production pays the whole cost of the roads. What is true of these roads is equally true of those of Ohio, Indiana, &c.

As an illustration take Chicago as a great railroad centre. The gross earnings of the principal railroads centering there, were, in 1868, as follows:—

| | Gross earnings. 1868. |
|---|---|
| Chicago and Northwestern railroad... | $13,941,343 |
| Chicago and Alton... ............ | 4,508,643 |
| Chicago, Burlington and Quincy...... | 6,812,809 |
| Chicago, Iowa and Nebraska......... | 631,782 |
| Chicago, Rock Island and Pacific..... | 5,231,980 |
| Cincinnati, Richmond and Chicago.... | 183,305 |
| Illinois Central.................... | 7,817,629 |
| Milwaukee and St. Paul............ | 6,547,646 |
| Mineral Point..................... | 102,119 |
| Ohio and Mississippi................ | 2,964,041 |
| Pittsburg, Fort Wayne and Chicago... | 8,041.181 |
| St. Louis, Alton and Terre Haute..... | 517,941 |
| St. Louis, Jacksonville and Chicago... | 240,000 |
| Michigan Central.................. | 4,716,293 |
| Michigan Southern................. | 5,124,108 |
| Toledo, Peoria and Warsaw.......... | 750,625 |
| Toledo, Wabash and Western........ | 4,013,207 |
| Western Union.................... | 758,785 |
| Dubuque and Sioux City............ | 963,186 |
| Dubuque and Southwestern......... | 176,217 |
| | $73,952,838 |

In 1860, only eight years previous, the gross earnings of such of these roads as were then in existence were $15,297,155, or but a trifle more than one-fifth of their receipts in 1868. We think no more rapid growth of business has ever been chronicled in any country.

While all these rivers, canals, and roads have been busy bringing down produce from swelling numbers of settlers, the traffic of the great outlets has been equally as active. We are to bear in mind that, in 1825, when the Erie canal opened, there was no transportation of produce from west to east of the mountains. Bearing that in mind, we shall inspect the following table with interest. It shows the tonnage and revenues of the five great outlets, for the year 1859, as follows:—

STATEMENT SHOWING THE NUMBER OF MILES OF RAILROAD CONSTRUCTED EACH YEAR IN THE UNITED STATES, FROM 1830 TO 1880, INCLUSIVE.

| Year. | Miles in Operation. | Annual Increase of Mileage. | Year. | Miles in Operation. | Annual Increase of Mileage. |
|---|---|---|---|---|---|
| 1830 | 23 | .. | 1856 | 22,016 | 3,647 |
| 1831 | 95 | 72 | 1857 | 24,503 | 2,647 |
| 1832 | 229 | 134 | 1858 | 26,968 | 2,465 |
| 1833 | 380 | 151 | 1859 | 28,789 | 1,821 |
| 1834 | 633 | 253 | 1860 | 30,635 | 1,846 |
| 1835 | 1,098 | 465 | 1861 | 31,286 | 651 |
| 1836 | 1,273 | 175 | 1862 | 32,120 | 834 |
| 1837 | 1,497 | 224 | 1863 | 33,170 | 1,050 |
| 1838 | 1,913 | 416 | 1864 | 33,908 | 738 |
| 1839 | 2,302 | 389 | 1865 | 35,085 | 1,177 |
| 1840 | 2,818 | 516 | 1866 | 36.827 | 1,742 |
| 1841 | 3,535 | 717 | 1867 | 39,276 | 2,449 |
| 1842 | 4,026 | 491 | 1868 | 42,255 | 2,979 |
| 1843 | 4,185 | 159 | 1869 | 47,208 | 4,953 |
| 1844 | 4,377 | 192 | 1870 | 52,898 | 5,690 |
| 1845 | 4,633 | 256 | 1871 | 60.568 | 7,670 |
| 1846 | 4,930 | 297 | 1872 | 66,735 | 6,167 |
| 1847 | 5,598 | 668 | 1873 | 70,683 | 3,948 |
| 1848 | 5,996 | 398 | 1874 | 72,623 | 1,940 |
| 1849 | 7,365 | 1,369 | 1875 | 74,096 | 1,713 |
| 1850 | 9,021 | 1,656 | 1876 | 76,808 | 2,712 |
| 1851 | 10,928 | 1,961 | 1877 | 79,089 | 2,281 |
| 1852 | 12,908 | 1,926 | 1878 | 81,776 | 2,687 |
| 1853 | 15 360 | 2,452 | 1879 | 86,497 | 4,721 |
| 1854 | 16,720 | 1,360 | 1880 | 94,622 | 7,207 |
| 1855 | 18,374 | 1,654 | | | |

The increase in mileage in 1881, will certainly exceed 10,000 miles, and may reach that amount on the lines west of the Mississippi river. One third, and possibly more of the whole increase of the year will be narrow gauge roads. The estimated cost of construction and equipment, or what is substantially the same thing, of capital and funded debt, of these 93 704 miles of railroad in operation in 1880 was $58,130 per mile, or for the whole, $5,-450,795,963.

The immense length of continued rail now enables an individual to travel from one extremity of the Union to the other without fatigue; not only are the distances shortened, but every appliance for comfort makes the journey, even to invalids, commodious. Among these are the palace cars of Pullman, Wagner and others, which are of three kinds: drawing room cars, with easy chairs, sofa, *tete-a-tetes*, and lounges; dining room cars, with kitchen attached, in which meals equal to those of the best hotels are served regularly, and most numerous of all, sleeping cars, furnished with excellent beds and toilet appliances, where the weary traveler can sleep as quietly as on his bed at home. These cars are all hung on rubber and the best steel springs, and are without any jolting or unpleasant motion at their greatest speed. The rail cars do not go the less rapidly that the passengers are well accommodated. There have been many instances not only of berths provided but of births taking place in the cars. Such an event happened on the Long Island cars, which were going at the speed of 40 miles per hour, and a grave difficulty sprung up as to where the young gentleman was born, a problem not easily solved,. when towns were passed at the rate of a mile in 90 seconds.

We have seen that the passenger of the present day does not occupy much time in performing long distances, and that these passages are by no means costly as compared with the inconvenient mode of locomotion in the olden time. Thirty-five years since it was recorded as a marvel that a gentleman made the distance from Chicago to Albany in 154 hours, or 6 days and 10 hours, and 24 days from New Orleans to Baltimore was considered as a matter of wonder. Now, 75 hours from New York to New Orleans is the usual mail time, and Chicago and New York are but 29 hours apart. A passenger now goes from Bangor to New Orleans in less time than was allowed, forty years ago, from Boston to New York. Since the completion of the Pacific railway, the time between New York and San Francisco has been reduced to six days; distance 3,344 miles, over 558 miles a day.

It is instructive to look back at the changes the means of locomotion have wrought in the views of passengers. At the close of the last century enterprising contractors advertised as follows:—

"Philadelphia Stage-Waggon & New York Stage-Boat, *performs* their *Stages* twice a *Week*. John Butler, with his waggon, sets out on Mondays from his House, at the Sign of the Death of the Fox, in Strawberry-ally, and drives the same day to Trenton Ferry, when Francis Holman meets him, and proceeds on Tuesday to Brunswick, and the passengers and goods being shifted into the waggon of Isaac Fitzrandolph's the same day, where Ruben Fitzrandolph, with a boat well suited, will receive them, and take them to New York that night. John Butler returning to Philadelphia on Tuesday with the passengers and goods delivered to him by Francis Holman, will again set out for Trenton Ferry on Thursday, and Francis Holman, &c., will carry his passengers and goods, with the same expedition as above to New York."

By this remarkably ingenious plan and diction of John Butler, everybody got to his journey's end in the course of time; "with the same expedition as above," that is, it appears, from Monday morning to Tuesday night, if Ruben Fitzrandolph's boat did not get aground or becalmed, or weather-bound, or driven off, in either of which cases the time of arrival was dubious. But honest John "with his waggon," was soon "cut out." Those "Yankees," immortalized by Knickerbocker, came down from the north and innovated even upon so admirable an arrangement as was here devised in the tap-room of the "Death of the Fox," Strawberry-ally, under the administration of Jefferson. Ruben's boat with its vicissitudes was abandoned, notwithstanding the attractions of the "Kill van Kull" passage, and a land route through adopted. The attractions of this route were set forth as follows:—

"For Philadelphia and Baltimore—Swiftsure Mail Stage.—A new line has removed from No. 2 Courtlandt street to No. 116 Broadway, and is now running between New York and Philadelphia, through a beautiful country, and on the short and pleasant road through Newark, Springfield, Scotch Plains, Bound Brook, Somerset, Arnwell, Coryell's Ferry, Cross Road, Crooket Billet, and Jenkintown to Philadelphia.

"To start from New York every day at 10 o'clock, A. M. (Sundays excepted,) lodge at Somerset, and arrive at Philadelphia next day afternoon. The Swiftsure is the only opposition stage from this city to Philadelphia and Baltimore."

There does not appear to have been much time saved by this new plan, any further than that the vicissitudes of the boats were exchanged for those of muddy roads. Spring coaches had, however, supplanted honest John Butler's wagon, since travelers had become more dainty. A few years more brought steam into competition for the use of travelers, and the number multiplied to such an extent, that, on the occasion of the great semi centennial jubilee anniversary of the National Independence, held July 4, 1825, it was recorded in *The Philadelphia Gazette*, that 300 New Yorkers were said to have been in Philadelphia. There were passengers enough to fill 35 *coaches!* Great doings, that, in the traveling way! What would Francis Holman have done with the crowd between Brunswick and Trenton? Traveling had clearly outgrown his arrangements. Well, 35 years more passed on, and railroad connections being constructed, the papers of the day contained a new advertisement of a trip to Philadelphia. It was no longer "John Butler and his wagon," but that "John Brougham with his company" would perform as usual in the evening at the New York theatre, then proceed by the cars to Philadelphia, and perform at the theatre there in the same evening, and return to New York to sleep. Thus two performances were had in two cities 90 miles apart, and the passage made both ways in the same evening by rail. The "limited trains" on the rival railroads between Philadelphia and New York now (in 1880–81) make the distance (90 miles) in 1½ hours, and have made it in 1.05.

The influence of these great improvements in travel has been in an eminent degree to consolidate population in cities, and these grow the more readily that the distance within which perishable food can be brought to market is so much increased by rapidity of travel. The elements of growth of a city are supplies of food, fuel, and water. Unless these are abundant and cheap, the disadvantages thence arising will counterbalance the geographical and commercial advantages of a city. To supply food the circle of country about the city which supplies market-gardens, dairies, etc., must be fertile and accessible. The width of this ring, or, in other words, the area thus devoted, is determined by the speed with which the produce can be transported. The distance of its extreme limits must not be greater than will permit the products to reach the centre in time for use; any improvement that enables a larger space to be gone over in the same time increases the area of dwellings and market-lands. The area thus commanded increases as the square of the distances. Thus, if the speed is doubled, the area is four times as large, if it is tripled, the area adapted to city supplies is *nine* times as great, consequently there will be nine times as much milk, butter, vegetables, food, and produce as before. Now, by railroads and steamships, the supplies of early vegetables and small fruits are brought from Bermuda, St. Augustine, Savannah, Charleston, Norfolk, the whole eastern shore region, southern New Jersey, Pittsburg, central and western New York, New England, and even from California. The effect of this on distant but accessible farms is important. If wheat is worth $1.00 in the city, and it cost 25 cents to get it there from a certain farming district, the producer will get 75 cents only. If the cost of transportation be reduced to 10 cents, then there is 15 cents to be divided between the city consumer and the producer.

Another very important development of railroads has been for city service. It is now nearly 40 years since, the city of New York having spread over a greater surface of ground than it was convenient to walk over, lines of omnibusses were started to run on the great thoroughfares, to carry passengers. The price was, at first, 12½ cents for a ride any distance on the line. This was gradually reduced to 6 cents. The small cars of the Harlem railroad, which then extended only up to Westchester county, began to carry passengers up as far as Forty-Second street, and in that vicinity, about 1838, but for twelve years after, that was the only road, perhaps, in the United States, carrying passengers from one part of the city to another in small cars drawn by horses. From 1850 to 1852 there began to be considerable interest in this mode of transit, and the Sixth Avenue, and soon after the Third Avenue line was established. There are now (1881) more than one hundred of these lines in the state of New York alone, which have cost over 60 million dollars and earn over 25 million dollars annually. These roads have an aggregate extent of more than 4,000 miles, and carry more than 600 million passengers in a year.

Recently, in our largest cities, there is complaint that this mode of transportation is not sufficiently rapid, and the use of dummy engines, underground tunnel, or arcade railroads, or steam driven roads not crossing the streets on their level, elevated railways in which the cars should be drawn by stationary engines, &c., &c., have been tried, to remedy the difficulty. The elevated railways and the tunnel roads have proved the most successful of these plans

Thus while the railroads favor the settlement of cities, by concentrating in them a large manufacturing and commercial population, which can draw cheap food from every section of the Union, they distribute that city population cheaply and speedily, enabling them to occupy a much greater territory, and at the same time concentrate the manufacturing operations in a manner to facilitate the greatest production of commodities which are required by the producers of food.

Railroads here serve a very different

purpose, and exert a much greater influence in the development of a country, than they do in the densely populated countries of Europe. In Europe, by facilitating travel, they yield a fair though not generally a large profit as investments. Their average cost per mile is much greater than here, but they do, to a limited degree, increase traffic and promote more constant intercourse of the people. Here the railroad is the pioneer of civilization. It plows its way through the dense forest, the unbroken prairie, or the waterless and almost desert lands, and at every mile of its onward progress, a village springs up, farms are laid out, orchards planted, the fields wave with the golden grain, and presently mines, manufactories, schools, churches and colleges, are called into existence, all along the line. These enterprises all pay from the start, and increase the national wealth in an almost incredible degree.

In September, 1859, the gross income of 257 railroads (all or nearly all then in existence) in the United States, was $111,203,245 for freight and passengers, or about $4.00 per head for each inhabitant. In January, 1868, a little more than eight years later, 373 railroads reported a gross income of $327,547,725, or more than $8,50 to each inhabitant. The reports of 1870 would undoubtedly add not less than twenty-five per cent. to this great aggregate. The number of miles of railroad completed in the United States, up to June, 1869, was almost half the length of railroads in the world. In 1859, the United States had 28,789 miles of railroad, and the entire globe (including the U. S.) 57,653. In January, 1869, the railroads of the world in operation were as follows:—

| | Miles. | | Miles. |
|---|---|---|---|
| United States | 48,860 | Belgium | 1,301 |
| Canada | 2,375 | Holland | 659 |
| Cuba | 431 | Denmark | 220 |
| Jamaica | 10 | Norway and Sweden | 800 |
| Argentine Republic | 427 | Russia and Poland | 3.167 |
| Columbia | 49 | Prussia and N. Germany | 5,764 |
| Brazil | 410 | South Germany | 2,861 |
| Peru | 128 | Austria and Hungary | 4,517 |
| Chili | 350 | Switzerland | 820 |
| England and Wales | 10,037 | Italy | 3.153 |
| Scotland | 2,282 | Turkey | 220 |
| Ireland | 1,928 | Egypt | 670 |
| Spain | 4.372 | British India | 5,000 |
| France | 9,515 | Australia | 850 |
| | | Total railroads of the world | 111,186 |

It is difficult to arrive with any considerable exactness at the cost of railroads in foreign countries. The following table is an approximation, except in the United States, Great Britain, and a few other European states where the figures are official, for the beginning of 1869:—

| | Miles. | Cost. | Cost per mile. |
|---|---|---|---|
| United States | 48,860 | $2,212,413,000 | $45.280 |
| Great Britain | 14,247 | 2,511,314,435 | 176.250 |
| France | 9,515 | 1,773,400.000 | 188.690 |
| Prussia and N. Germany | 5.764 | 380,424,000 | 66,000 |
| Austria and S. Germany | 7,388 | 499.000,000 | 71,000 |
| Belgium | 1,301 | 118,911,460 | 91,400 |
| British America | 2,385 | 119,950,000 | 56,000 |
| Cuba | 431 | 19,395.000 | 45.000 |
| Colombia | 49 | 7 350,000 | 150,000 |
| South America | 888 | 62.160,000 | 70,000 |
| Russia | 3,167 | 285,030,000 | 90,000 |
| Sweden and Norway | 800 | 72,000,000 | 90,000 |
| Switzerland | 820 | 73,800.000 | 90.000 |
| Italy | 3,153 | 315,300.000 | 100.000 |
| Spain | 4,372 | 304,488.785 | 70,000 |
| Turkey | 220 | 26,400 000 | 120,000 |
| Africa | 670 | 80,400,000 | 120,000 |
| India | 5,000 | 371,730,220 | 75.000 |
| Australia | 850 | 63,750,000 | 75,000 |
| Other small States | 880 | 61,600,000 | 70,000 |
| | 111,187 | $9,430,116,840 | $92,681 |

The estimated amount of these items in 1851 was: Miles of railroad, 48,114, cost, $3,823,200,814, cost per mile, $79,000. The greatest extension of the railroad system has in all cases been in the countries to which there is the greatest immigration. British America, South America, India, Australia, Russia, Italy, Spain, and Egypt, are the foreign countries which have increased their railroads most rapidly. With most of these countries (we may perhaps except Australia, India and Russia) there is a limit which must, in a few years, be reached beyond which the construction of railroads will not be profitable. With the United States, on the contrary, there is no conceivable limit (unless some better method of locomotion should be devised,) to the construction of railroads. Our vast territory, with its rapidly increasing population, is constantly requiring new routes to bring produce, coal, metals, or manufactures to market, and to transport the tens of millions of passengers and immigrants who must rely on them for transportation to their homes or their business. We are already adding 7,745 miles a year to our railroads, and shall soon increase to 10,000 miles a year.

We have purposely delayed the consideration of our railroad routes to the Pacific coast to the close of this article, both because we regard them as in some measure dissevered from the more local railroad routes and because their vastness will be more easily comprehended if they stand by themselves.

The accession of California to our territory and the speedily following discovery of gold there, led necessarily to the improvement of the routes for reaching there. The long and perilous journey around Cape Horn was too tedious for our enterprising, impatient gold-hunters. The Panama railroad across the isthmus of that name, was commenced in 1850 and completed in 1855, at a cost of $7,500,000, which subsequent additions and purchases have increased to $8,000,000. It is about 49 miles in length, and its gross earnings have ranged from $1,300,000 to $2,000,000. This shortened the voyage to San Francisco, to about three weeks. But other routes were demanded, which should abridge the time of transit still more. The Nicaragua and the Tehuantepec routes were tried with but partial success; repeated explorations were made to ascertain the practicability of a ship canal across some portion of the isthmus, which connect North and South America, but thus far, without practical result. Between 1852 and 1861 several exploring expeditions were sent out to ascertain the best route across the continent within the bounds of our own territory, and their costly reports were published by the government. The feeling that it was indispensable that the Pacific states should be bound to the east by a continuous railroad, which had been gaining strength, was quickened into greater activity by the war; and while in the midst of the desperate struggle, in July, 1862, Congress passed an act chartering the Pacific railroad. There were some defects in the charter, and no company was formed till October, 1863, when the Union Pacific and soon after the Central Pacific was organized. By the charter the capital stock of the entire route was to be $100,000,000, and the government granted them a roadway of 200 feet on each side of the track, and alternate sections of land for twenty miles on each side of the road; and in addition its bonds, maturing in 30 years, bearing six per cent. payable in gold, for $16,000 per mile for the plain, $32,000 per mile for the steeper grades, and $48,000 per mile for the deep cuttings and tunneling. They were, moreover, authorized to issue their own bonds to an equal amount with these government bonds, at the same rate, and these lands were to be a first mortgage (the government bonds being a second mortgage) on the road. With these ample resources the two companies began at their respective ends to build the road in 1865; the Union Pacific commencing at Omaha, Nebraska, and the Central Pacific, at Sacramento, California. The Central Pacific built 742 miles, much of it through the mountains, and the Union Pacific 1,032 miles The junction of the two roads was effected May 15, 1869, and regular daily passenger trains are run each way, as well as numerous freight trains. It is difficult to ascertain what has been the cost of these roads. The bonds issued for the Union Pacific were $58,656,000, aside from its land grant bonds, and its entire cost is put down by the company for road and equipment as $82,445,012. That full payments on subscribed stock have not been called for is evident. The Central Pacific has issued $45,578,000 of bonds, and computes the cost of its road at about 62 million dollars; while the Western Pacific, extending from Sacramento to San Francisco, has also received its bonds, and has cost about 15 millions more, making the aggregate cost of these lines, aside from their lands, about $160,000,000. This is too much, even for the grandest enterprise ever undertaken by human hands, but it is to be remembered that it was begun in the midst of a great war and driven to its completion under the pressure of great difficulties.

But three routes across the continent are as much required as one; and the Northern Pacific, extending from St. Paul, Minnesota, to Puget's Sound, Washington territory, with branches to southern Idaho and Montana, is already under contract, under the energetic management of Messrs. Jay Cooke & Co.; while there are two southern routes, one the Kansas Pacific, and the other, a road from Memphis along the 32d parallel; but both, terminating in San Diego, California, are pushing westward. If a ship canal, either across the isthmus of Darien, the isthmus of Panama, or that of Tehuantepec, shall be found practicable, the construction of that also is in the near future, and by these various routes the great trade of eastern Asia is destined to find its way through our continent, as the most direct route, both to America and Europe. The northwest passage, of which Columbus dreamed so long, has been at last discovered in a way of which Columbus never dreamed, and the continent he discovered will be the market for the vast commerce of Cathay.


PANAMA RAILROAD.

# VIEWS ON THE CENTRAL PACIFIC RAILROAD.

To those unacquainted with the locality it is impossible to convey by description any adequate idea of the irregularities of surface which occur in the Sierra Nevada mountains, which are traversed by this line.

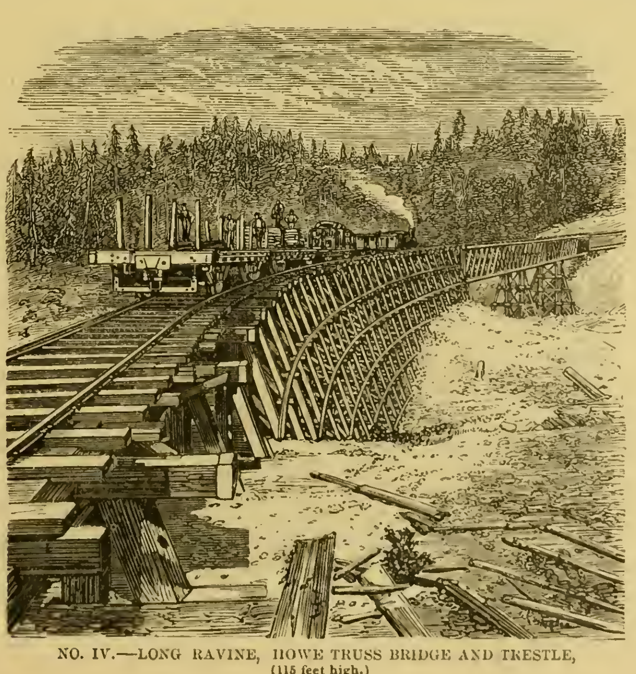
NO. I.—TRESTLE OPPOSITE AUBURN.

The tunneling required has been of small extent. The peculiarity of the line is the very extensive employment of trestle bridging, and it is with the view of illustrating this that our engravings have been chosen, Nos. 1, 2, 4, 5, and 6, being examples of trestle bridging, and No. 3 showing a cutting 63 feet deep and 800 feet long through cemented gravel and sand, of the consistency of solid rock, and which is

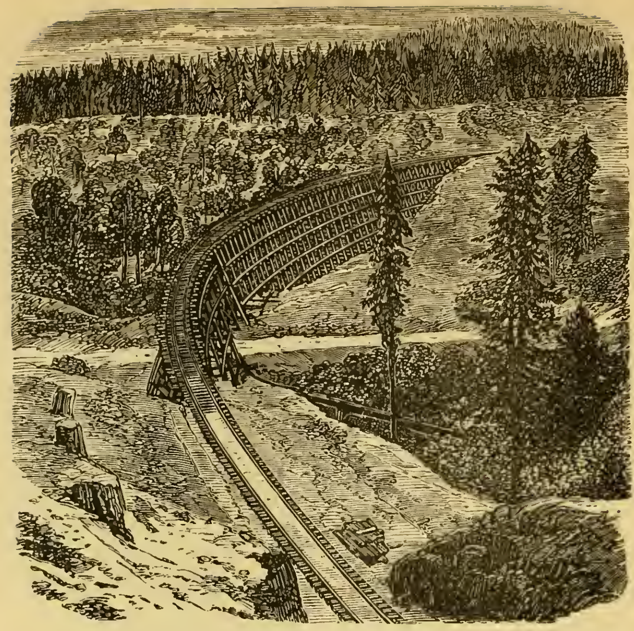
NO. II.—TRESTLE AND TRUSS BRIDGE, CLIPPER RAVINE,
(100 feet high.)

NO. III.—BLOOMER CUT,
(63 feet deep, 800 feet long.)

only to be moved by blasting. The trestle bridging has been all constructed as strongly as possible, and of the best obtainable material. The ties, stringers and caps are of the best quality pine (that from Puget's Sound, nearly equal to oak,) and the posts, braces, sills and piles of red-wood. The main posts, 12 inches square, are placed perpendicularly, let into a sill of the same dimensions with mortice and tenon, immediately under the bearing of the track stringers. Outside the main posts, two posts, 12 in. by 12 in., extend down, with a run of 1 foot in 3 inches, to the sill to which they are tenoned, beside being bolted at the top to the main posts with inch bolts and cast-iron washers. The sills rest on piles on stone foundations. Piles, when used, are driven so as to come directly under the main posts and braces. The posts are capped with a timber 12 inches square and 9 feet long, into which the posts are tenoned and pinned. Upon the caps rest corbels 12 inches square and 9 feet long, and upon them are laid the string-



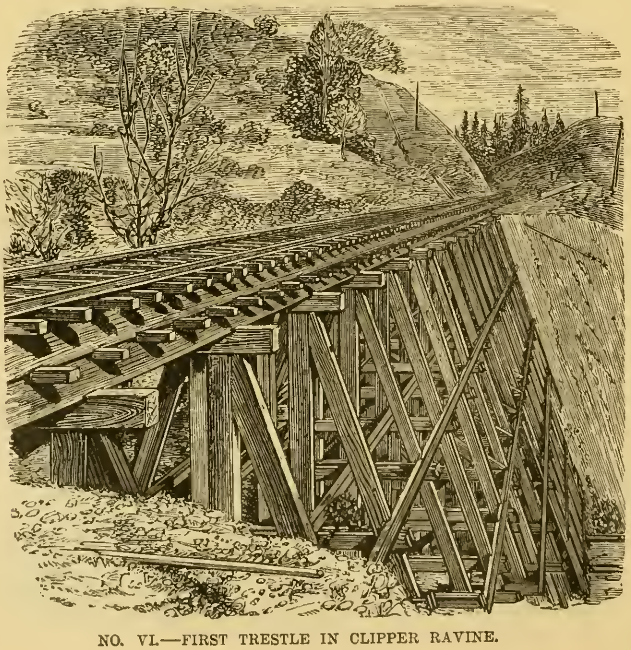
NO. IV.—LONG RAVINE, HOWE TRUSS BRIDGE AND TRESTLE,
(115 feet high.)



NO. V.—TRESTLE AT SECRETTOWN,
(1,000 feet long, 50 feet to 90 feet high.)

ers, 12 in. by 15 in., secured by iron bolts passing down through them to the corbels. The caps are notched 1 inch to receive the corbels. The cross ties, or sleepers, are securely fastened to the stringers, and upon the sleepers are laid the rails in the ordinary manner. The "bents" or frames are placed at intervals of 15 feet from center to center. Trestling thus constructed is said to last from eight to fifteen years. When necessary it can be renewed at small cost, or filled with earthen embankment by transporting material on cars at far less cost and trouble than would have been incurred in constructing an embankment at first.

It now takes three weeks or more to reach San Francisco *via* Panama, from New York. By railroad, the journey can be made in about five days.



NO. VI.—FIRST TRESTLE IN CLIPPER RAVINE.

# STEAM.

BY JOHN C. MERRIAM.

## CHAPTER I.

### INTRODUCTORY.

#### HISTORY OF STEAM ENGINE.

One hundred years ago, a harmless vapor arose with the morning sun, and floated o'er our heads, remarked by the artist, poet, or philosopher, but almost unheeded by the mechanic, and only regarded by the mariner as a prognosticator of the wind.

How is it to-day? From myriad towering columns, o'er which the fierce fire-king his sombre mantle flings, gushes, in mimic clouds, the quick breath of our new-born Titan. The ancient rocks echo to his shrill voice, and tremble as he rushes by. He troubles the waters, and rides on their crest defiant. O'er hill and dale, and lake and river, is his white flag unfurled, proclaiming peace to all nations. From the pine of the frozen north, to the palmetto of the sunny south, his twin track tunnels the mountain, belts the prairie, and spans the flood. Mightiest of kings is this son of fire! proudest of monarchs is this genius of the lamp and the fountain!

In an article like this, it is not necessary that we should dwell upon the genius of James Watt — abler pens have awarded him the fame he so richly deserves, and a proud monument in Westminster Abbey tells the passing stranger that it was

NOT TO PERPETUATE A NAME,<br>
WHICH MUST ENDURE WHILE THE PEACEFUL ARTS FLOURISH;<br>
BUT TO SHOW<br>
THAT MANKIND HAVE LEARNED TO HONOR THOSE<br>
WHO BEST DESERVE THEIR GRATITUDE,<br>
THAT THE KING,<br>
HIS MINISTERS, AND MANY OF THE NOBLES<br>
AND COMMONERS OF THE REALM<br>
RAISED THIS MONUMENT TO<br>
JAMES WATT,<br>
WHO, DIRECTING THE FORCE OF AN ORIGINAL GENIUS,<br>
EARLY EXERCISED IN PHILOSOPHIC RESEARCH,<br>
TO THE IMPROVEMENT OF<br>
THE STEAM-ENGINE,<br>
ENLARGED THE RESOURCES OF HIS COUNTRY,<br>
INCREASED THE POWER OF MAN,<br>
AND ROSE TO AN EMINENT PLACE<br>
AMONG THE MOST ILLUSTRIOUS FOLLOWERS OF SCIENCE,<br>
AND THE REAL BENEFACTORS OF THE WORLD.

What greater praise could be awarded to him than this? How could his unrivalled genius be more concisely expressed, or clearly acknowledged? and yet, at that time, they had but begun to see the stupendous results of his inventions. To realize the inventive mind of James Watt, it requires careful study, and thorough mechanical knowledge, even at this late day; and when we consider that with him all was comparatively novel, we pause in astonishment at a mind so fertile in mechanical devices.

England, ever true and grateful to her *own* genius, has fitly honored her greatest inventor, while America has suffered genius as great to die, unrewarded in life, and forgotten in the grave; but she has not neglected to profit by their inventions; and it is our purpose to show, in this article, how great have been the results.

The first steam engine of which we have any knowledge in America was at the Schuyler copper mine, Passaic, N. J. It was, more properly speaking, an atmospheric engine, and was imported from England in 1736, and put up by a Mr. Hornblower. The first engine that was constructed in America was built by Christopher Colles for a distillery in Philadelphia; the machine was, however, very defective. It was built in October, 1772, and was, like the other, an engine upon Newcomen's plan.

Thus it will be seen that it is less than a hundred years since America took her first lessons in a science that was destined to work such a revolution in the whole world; and her birth, as a nation, may be considered as cotemporary with that of the steam engine. In 1787, John Fitch, of Connecticut, built, in Philadelphia, the first condensing engine, and this without the aid of Watt's experiments—for it was only in the year 1786 that the latter patented, and made public, his most important improvements; and we have every reason to believe that Fitch was at first ignorant of them. With the assistance of common blacksmiths, he constructed a low-pressure engine, and, more than this, applied the motor to a steam-boat. Then came the experiments and success of Robert Fulton, a man whom we have not forgotten to honor; the improvements of Stevens, to whom we owe our great success in river navigation, and the energy and perseverance of Oliver Evans, the first to apply the principles of the high-pressure, or non-condensing engine, to common use, and to demonstrate its advantages not only for the stationary engine, but also its adaptability to carriages on common roads; from which we may date the invention of the locomotive engine, for it was only the experience of Stephenson in tram-roads that led him, at a much later day, to the invention of the latter, and Watt's engines would never have become applicable thereto, on account of their great size.

In spite of the difficulties under which a young nation labored, from the want of an accumulated capital, we took a start from the first introduction of the locomotive engine, that has astonished the world; and have grown a race of civil engineers that, with a limited amount of money, have produced effects wonderful even to themselves. Well may Americans be proud of the results of their inventive genius. To the general reader these events have come to be a matter of course, and steam, with its thousands of detailed improvements, is looked upon as something wonderful, but inexplicable; the mass of people understanding little or nothing of its nature. We propose, then, to explain, as simply as possible, the cause of this great effect, and, dropping technicalities, to give the great public a concise idea of steam, and the steam engine, before proceeding to the results of its use.

When Watt constructed his first engines, he used them to replace horses in the mines, and, in order to give some idea of their value, he reckoned his engines as at so many horses' power; and the power of a horse was computed from the effect produced by a horse raising a weight to a certain height in a given time: this he computed as 33,000 lbs., raised, in one minute, to the height of one foot. The following description, from S. Holland, chief engineer of the English navy, concisely shows the manner of obtaining the horse-power of a steam engine:—

"Work is a term in mechanics of recent origin, but of great utility; it means a compound of force (or pressure) and motion. Work is said to be performed when a pressure is exerted upon a body, and the body is thereby moved through space. The unit of a pressure is one pound, the unit of space one foot, and work is measured by a 'foot-pound' as a unit. Thus, if a pressure of so many pounds be exerted through a space of so many feet, the number of pounds is multiplied into the number of feet, and the product is the number of foot-pounds of work; hence, if the stroke of a steam engine be seven feet, and the pressure on each square inch of the piston be 22 pounds, the work done at each single stroke, for each square inch of the piston, will be 7 multiplied by 22, equal to 154 foot-pounds. Power contains another element in addition to those contained in work. It implies the ability to do so much work *in a certain period of time;* and, in order to have a proper idea of it, a unit of measure is also employed. This unit is called a 'horse-power,' and is equal to 33,000 pounds raised through a space of one foot in one minute; it is the execution of 33,000 foot-pounds of work in one minute. To find the horse-power of a steam engine is to find the number of pounds pressure on the piston in square inches, and to multiply this by the number of feet travelled by the piston per minute, which gives the work; then this is divided by 33,000 pounds, and the quotient is the horse-power, which is usually abbreviated H. P. As the pressure is always indicated by the square inch, the number of square inches in the area of the piston has to be found. This is done by squaring the diameter of the piston, and multiplying this by the decimal, ·7854."

The horse-power of an engine is always calculated with the steam in the boiler at a moderate pressure, and, consequently, if the steam is kept at a higher pressure, it will be capable of more work, and the engine will be of a greater effectual horse-power than the one given. Hence the terms *real* and *nominal* horse-power. The term horse-power is, in reality, of itself nominal, as Watt, in order to have his engines give satisfaction, added some twenty-five per cent. to the real work of the best horses in Cornwall. Having thus given an explanation of this term concisely, that it may be remembered, we will endeavor to instruct the general reader as to some other terms not always understood, although constantly made use of in conversation.

Engines are divided into two kinds: low and high-pressure, or condensing and non-condensing. The low-pressure engine was, in the main, invented by James Watt; and its peculiarity consists in the fact that, while the steam is entering upon one side of the piston, the steam upon the other side is condensed, and forms a vacuum that adds to the power of the engine from twelve to fourteen pounds to the square inch. Thus, with steam at the pressure of twenty-five pounds only, we have an effective force of nearly forty. The low-pressure engine has the advantage of not carrying so much steam, and, consequently, is less dangerous. From the fact, however, that it is much more complicated and expensive, it is not often used on land, unless for large engines, and its size prevents its adaptation to locomotion.

The high-pressure engine was invented by Leopold and Trevithick, ' subsequent to the other. Oliver Evans, of Philadelphia, was the first to advocate its use, and, in fact, to practically apply it. Engines of this description discharge the steam, after using it, into the air, and have, consequently, the resistance of the atmosphere to contend with; they are, however, much cheaper, and with properly built boilers are not necessarily more dangerous. All our locomotives are upon this principle, and the draft of the furnaces is accelerated by the rush of the waste or exhaust steam, as it passes into the chimney. The pressure of steam used in our high-pressure engines, averages more than in any other country; from eighty to one hundred pounds per square inch being the common average. In order to prevent an amount of steam from accumulating to a higher pressure than this, the safety valve is placed upon the boiler, so constructed that, when the pressure rises above the point desired, it will open the valve, and allow the surplus to escape. Over-weighting this valve, or not taking proper care of it, and allowing it to rust into its seat, are fruitful sources of boiler explosions. No engineer should run an engine without trying his valve at least once a day.

It is important that the water in the boiler should always be at about the same height; not full, as in that case water is apt to pass over into the cylinders, and the engine is said to be flooded; nor too low, for the heat of the furnace would melt the flues, if they were not covered with water. Various automatic contrivances have been invented to keep the water at the true level; but their liability to get out of order has prevented their use, and engineers unite in the opinion that man's judgment alone is comparative security. To assist the competent engineer, there are several devices. The most common are the three gauge-cocks, placed, the one above the other, at some three inches apart—the centre one being the desired level; by trying these cocks, the exact height can be readily seen. Other water gauges have been in use, some of them since the earliest engines were constructed, upon the principle that a float upon the water will indicate, by means of a rod, its exact height. A glass tube, connected above and below the water line, is much used in our steamers.

In order to determine the steam pressure at any point below that at which it raises the safety valve, various steam gauges have been in use from time to time; the most common in steamboats is called the syphon gauge, and works upon the principle of balancing a column of mercury in a syphon tube. Within the last ten years the spring gauge has come into general use in locomotive and other engines; they occupy but little room, and, if occasionally tested, answer every purpose of the more cumbersome syphon. With the exception of the Bourdon (French) and Schaeffer (Prussian), all the spring gauges in use in the United States, some thirty in number, are American inventions, and both of the foreign gauges have been improved upon, and are made in a superior manner here.

The passage between the boiler and the cylinder was at first opened and closed by means of a cock; the slide valve, modifications of which are now universally used, was the invention of Murray, of Leeds, England, in 1810. The piston was at first packed with hemp, saturated with grease; the brass rings, now used, were invented by Murdock & Aiken, of Glasgow, in the year 1813. The paddle-wheel between two boats was first used by William Symington, in Scotland; but the side wheel, as now used, together with the screw propeller, were both made use of in the models by John Fitch. His first steamboat, however, was worked by oars, or paddles, after the same manner as an Indian uses them. The first boat that carried passengers, built by John Fitch in 1789, was propelled by a set of paddles at the stern. The North River, of Clermont—Fulton's first passenger boat—was driven by the present form of side wheel; she made a successful trip in the year 1807.

One of the greatest improvements of steamboats with regard to speed was made by Robert L. Stevens, who added the false bow to a boat constructed by him in 1815. She attained the speed of 15 miles per hour, a great improvement over the North River (which only made four miles per hour), but seeming very slow at the present date, as contrasted with the time made at a trial trip of the Daniel Drew, in 1860, which was 22 miles per hour against the tide.

It is quite curious to follow the various improvements that have been made upon the steam engine, and to see how the present simple apparatus was settled upon. It required years of experiment before the crank was adopted, notwithstanding that the same device had been in use in the common foot-lathe for several centuries. It was finally adopted by Picard; but, after his invention, Watt patented a much more complicated method of transmitting the reciprocating into the rotary motion. This was called the sun and planet motion, and went out of use only after repeated trials with the crank. It is true that the latter was patented; and the fact that Mr. Watt wished to avoid another patent, had much to do with this persistent trial of an inferior device. In the use of the locomotive engine, also, it was only after years of experiment that it was realized that the traction of the wheel upon the rail was sufficient to propel the carriage not only upon a level, but also up a very steep grade.

On the line of the Pennsylvania railroad, beyond the town of Altoona, the track has an ascending grade over the mountains of over 100 feet to the mile, yet a passenger train of six or seven cars, with the assistance of two locomotives, surmounts the grade at a speed of nearly thirty miles per hour, and this, too, upon a road that lies coiled upon the side of the mountain like a huge serpent. So short are its curves, that the locomotive is quite visible from the fourth car during many parts of the ascent. No other nation in the world can show so great a triumph of civil engineering as this. The first road that was constructed at this place was worked by stationary engines, and the cars were drawn up by ropes and chains. This was a copy of European engineering; but American genius is destined always to rise superior to imitation, and it is, in fact, only when it so rises, and trusts to its own gigantic plans, that the true power of American character shows itself. The stolid English engineer imitates the Egyptians and the Romans, and piles stone upon stone, and iron upon iron. The American imitates nature, with whose great works he is in constant communion, and, like the spider, constructs a bridge light in appearance, but sufficiently strong to withstand the tempest and the storm, and bear with an easy vibration, double, nay, triple, the load put upon it. Only an appreciation of the grandeur of such a fall as that of Niagara, could fit a man to construct the bridge that spans its river.

But to return to the improvements in the steam engine itself. When we look at the combination of them, as at present in use, we cannot but feel the wonderful genius therein displayed. It is but a few years since the steam engine, although vastly superior to horse power, was a cumbersome and expensive machine both to construct and repair; and although it is at present far from being perfect, yet the difference in its first cost, and the amount of fuel it uses for the same effect, is astonishing. Stand and look at some of our immense stationary engines, and see how noiselessly and steadily they turn the ponderous wheel! One would think a child's power could stop it. Then pass on, and on, through the groaning mill, and see the labor of thousands of men performed by this untiring giant. It is only after seeing the work he accomplishes, you can realize his strength. Stand upon the western prairie at night. The moon silvers a twin track that glistens far into the darkness; soon you hear a distant hum that grows upon the ear, and detect a faint spark that brightens as you gaze; anon the sound increases, and the eye of the iron horse overpowers the moon's pale gleam; he sees you, and screams his shrill warning. Who can help starting as he rushes by, or not feel as though steam itself were personified. Mark the groaning train, with its living freight, tearing madly through the darkness, bearing absent friends to the loved at home, or perhaps good news from the beloved afar.

Again, stand upon the Battery, at New York, and watch the almost countless fleet of steamships, steamboats, propellers, and tugs; some moving steadily toward the Narrows, as though conscious and proud of a power that can span the ocean in so short a time; others plashing and dashing madly about, or clinging to some gigantic ship, and tugging manfully at its side, when old Boreas has left it helpless; others, again, in holiday attire, bearing a happy throng over the glad waters, and tuning the voice of this giant slave into fitting melody for the joyous hour. Here comes the Sound steamer, a floating palace fitted up in almost regal elegance, drawing but little water, and yet a staunch sea-boat, large, and, to the foreign ship-builder, apparently top-heavy, yet fast as the racehorse, and frequently tried by the stoutest gales. Up and down both rivers ply the ever busy ferry-boats — movable bridges, ever crowded with passengers. Did Fulton's wildest dreams ever picture a scene like this? Did John Fitch ever imagine a triumph so wonderful? Yet it is all the work of steam; and to them we owe, in part, the bands by which we hold this half-tamed Titan. Not only are these steamers propelled by steam, but his aid is called in both to load and unload them, and, in the hour of danger, steam works at the pumps with untiring hands. Not alone in the large manufactory, the gallant steamer, and the rushing car, does the vapor of water show its strength and usefulness, but thickly strewn about our cities and villages, delving in the mines, driving the rattling press, it helps all trades, and multiplies the power of man a thousand fold. Cities have sprung up under its magic touch, and everywhere we see traces of the king of motors—steam.

And to whom are we indebted for all this improvement, this immense power? Mainly to the American inventor, and our patent laws. It is not too much to say that one-third of the patents issued at the United States Patent Office for the last thirty years related either directly to the steam engine, or to machines intended to be driven by it; nearly all of them patented by citizens of the United States. The use of steam expansively was an English invention, but it is doubtful whether it was profitably used until improved upon in America. American locomotives have borne off the palm wherever they have been brought into contact with those of other nations. In ocean steamers we may be second, but the reason is plain: foreign builders have the assistance of rich and powerful governments, while our own success is entirely due to private enterprise, with a limited amount of capital.

As for steamboats for rivers and lakes, to which our immense inland navigation has turned the attention of our mechanics, we are far ahead of our rivals. The Yangtsze and Peiho, built for the Chinese coast, have never been equalled by England, as is sufficiently plain from the following China overland trade report, written by one of their own countrymen:—

"Steamboat builders in England, and Scotland, too, are certainly the most adroit 'shavers' living. They turn out so many miserable botches, that really we think a very great majority of the community would, were they 'going into steam,' resort to the United States. As far as river navigation is concerned, our attempts to compete with Jonathan are simply absurd, as those who own English river steamers here at present, must, ere this, have discovered to their cost. But, even in sea-going steamers, 'if the proof of the pudding be in the eating,' we should wish to know where the British steamers are, which are as swift, as safe, as commodious, as serviceable, or as economical in expenditure of fuel, as the Yangtsze or the Peiho? We maintain that every boat sent out here from England or Scotland, on China account, whether for coast or the river, has either been a miserable failure, or a glutton for fuel. We do not make one exception. We do not like to mention names, as we are averse to depreciate people's property, but we confidently leave it to every unfortunate sufferer to say whether or not we are correct in our statement.

"We, of course, except the P. & O. Company, as they seem to have a secret plan of constructing boilers, which makes them last as long as the boat; that is, for an indefinite period. We declare one never hears of any thing occurring to one of the company's boilers, nor any of their boats being laid up to have a new one, or the old one mended.

"We will take, for instance, the Chevy Chase, which vessel, we believe, cost on the Clyde about three times the sum that the Yangtsze cost at New York. Now the Yangtsze has been running nearly three years hard upon the coast, making unprecedentedly swift passages, and never was docked until the other day. The Chevy Chase will not carry so much as the Yangtsze, nor has she as good accommodation; but she burns twice as much coal, and, in a race between this and Shanghai, would be sparingly backed. She is about as strong again and as heavy again as there is the slightest occasion for; and has clearly twice as much power as she can bear, for the weight of it sinks her. She is a very shallow craft, and her deck is so near the bottom, which contains an enormous mass of iron, that compasses will not act, and it becomes dangerous to run her in thick weather. She will bring grief to the hearth, but never grist to the mill; and the sooner she is altered the better. She should be made into a screw propeller, and a suitable vessel built for the valuable and powerful machinery now fitted in her.

Having spoken thus, in general terms, of the steam-engine, it may not be amiss to give a description of the simplest form thereof, by describing its component parts in terms easy to be understood and remembered. A steam-engine consists, then, of a *cylinder*, closed at both ends, having fitted to it a piston, whose rod passes out at one end through a steam-tight hole, called a *stuffing-box*. The piston consists of a skeleton, technically called a *spider*, having three brass rings made thin enough to yield to the inequalities of the cylinder as it wears, and forced against it by springs resting upon the spider, and held in place by a plate commonly called a *follower*. The steam is admitted to the cylinder on the side, at each end, through what are called the *ports;* the two ends of the ports are brought near each other at the point where they enter the *steam-chest*—a small box near the centre of the cylinder. These ports are alternately opened to the boiler and the atmosphere, by a sliding valve that obtains its motion from what is called the eccentric, which is placed upon the main shaft. The piston-rod is fastened, at the external end, to a *cross-head*, which communicates its motion to the *crank-rod*, and through it to the main shaft. In stationary engines, working by a single cylinder, it is evident there will be two points at which the rod has no power over the crank; these points are called *dead centres*, and to overcome them the momentum of the balance-wheel is used. In the locomotive, two cylinders being used, they are set *quartering* (at right angles with each other,) and the one overcomes the dead centre of the other. In the marine engine the motion of the wheel is continued by the action of the water, as the boat advances, and, consequently, no balance is required.

If, after a part of the steam has entered the cylinder, the induction valve be closed, the expansion of the steam would continue the stroke of the piston until the pressure became the same as that of the external air, or until the piston had reached the end of its stroke. Thus, if the pressure of the steam was eighty pounds per square inch in the boiler, and the valve was closed after the piston had made one quarter of its stroke, it is evident that the pressure would constantly decrease up to the end of that stroke, and that the average pressure would be less than the pressure in the boiler, but at the end of the stroke there would be but very little waste steam; in other words, the pressure remaining in the cylinder would not be in so great an excess over the atmospheric pressure as if the steam had followed the piston throughout its entire stroke. To show this more plainly, it must not be forgotten that steam at eighty pounds pressure is, in reality, steam at ninety-five pounds to the square inch, working against fifteen pounds (the atmospheric pressure,) or a *difference of pressure* of eighty pounds; therefore, at the end of the stroke, the ninety-five pounds would have become twenty-three and three-quarters of pressure working against fifteen pounds atmospheric, or a difference of eight and three-quarters of pressure; so that, when the cylinder was opened by its exhaust to the air, there would be only eight and three-quarters of a pound to the square inch thrown out into the air, and thus wasted, while you have had an average of sixty-seven pounds to the square inch throughout the stroke of the piston, working against fifteen pounds of atmospheric, or an actual *difference of pressure* of fifty-two pounds. Had you used fifty-two pounds of indicated pressure, following the full stroke of the piston, it is evident you would have thrown into the air the contents of the cylinder at that pressure, instead of at eight and three-quarters, as by the *cut-off*. This is, in brief, the theory of the cut-off; but, like many other improvements, it has been carried to an extreme, and has thus become a positive evil. In order to realize this, notice carefully the following; If steam, at thirty pounds per inch, as indicated, be used in a cylinder, cutting off at one-quarter stroke, what will be the pressure at the end of the stroke? Thirty is, as before shown, forty-five against fifteen: at the end of the stroke it will then be eleven and one-quarter against fifteen, or a back pressure of three and three-quarter pounds. Many people, who have found fault with cut-offs, have overlooked this.

In explaining the cut-off, we have not taken into consideration the condensation of the steam from its expansion; and this is, of itself, a very important item of loss, as is also its increased friction; so that the actual gain from the use of a cut-off is not as great as it would theoretically appear.

The whole subject of cut-offs and the use of steam expansively, was, in 1862–1865, put to the test of careful experiment both in England and the United States, and the theory of Mr. B. F. Isherwood, at that time chief engineer of the U. S. Navy, "That the maximum gain with any possible cut-off, in the saving of fuel, or the increase of work, could not exceed 18 per cent.," was completely exploded. Mr. Isherwood claimed this as his discovery, and during the whole war had been constructing the marine engines of the Navy without any regard to the carrying out of the principles of expansion. A series of careful experiments, with different engines, and under the supervision of experienced engineers, established the fact that with engines of proper construction, the increase of work was in the ratio of not less than 27 revolutions by using the cut-off, and working the steam expansively, to 20 revolutions without it, and that the saving of fuel was at least in the ratio of six tons with the cut-off, to seven without it. Some engines and some forms of cut-off did much better than this, one or two increasing the speed over 100 per cent. and saving more than 30 per cent. of the fuel; but with average marine engines the lowest result attained was that stated above.

Having thus stated some of the most important parts of a steam engine, we will now speak of some of its accessories. In order to give a uniformity of speed to the machinery driven by a steam engine, no matter how much the work it has to do may vary, the governor was invented: it consists, in its simplest form, of two balls revolving around an upright shaft, and suspended from its top by rods; if revolved with great rapidity, these balls are carried by their centrifugal motion to the greatest circumference that their rods will allow them; if moved slowly, they will assume their smallest circumference, and, by these motions, close or open the throttle, or, in the improved engines, vary the cut-off: thus controlling the speed of the engine, and keeping it always at nearly the same velocity.

In order to keep the boiler filled with water to the requisite level, one or more pumps are placed in connection with it, of a capacity to supply it, if only working part of the time. These pumps should always be provided with a *pet-cock*, which, when opened, will show whether the pump is doing its duty, as the valves of any pump are liable to become clogged and useless. On the locomotive engine the casual observer will notice that the engineer frequently tries these cocks, which are placed upon the side of the engine, and, in fact, that he sometimes tries them to the detriment of dandified-looking individuals, who approach too close to the iron steed. The pet-cocks are not, however, as much used as they should be, and, in fact, are very frequently left out altogether in the construction of the stationary engine. The safety valve, as at present in use, has a great many faults: it was originally the invention of Denis Papin, of France, and was constructed by him in his experiments with what was called Papin's steam digester—a machine for dissolving bones, etc. It consisted, as at first constructed, of a small round plate covering a hole, and held in its place by a weight suspended from a lever, whose fulcrum rested upon the plate. But little improvement has been made upon this simple device; it is now tapered, to fit a counter-sunk hole, and possesses the advantage of being more difficult to calculate. But one of its chief faults is in the fact that the point of contact between the lever and valve is so large, that its wear creates a constantly varying leverage. This could be obviated by making the point of contact a knife-edge instead of a half-inch pin. Another disadvantage in the common safety valve is the fact that the engineer has the power of weighting it to an unlimited extent. We have seen this difficulty obviated by an American invention. The weight is suspended in the boiler directly from the valve, and consists of the greatest weight the boiler should ever be allowed to carry. The lever is now so applied, that its tendency is to always lighten the valve, so that the more it is weighted the less steam can be carried.

## CHAPTER II.

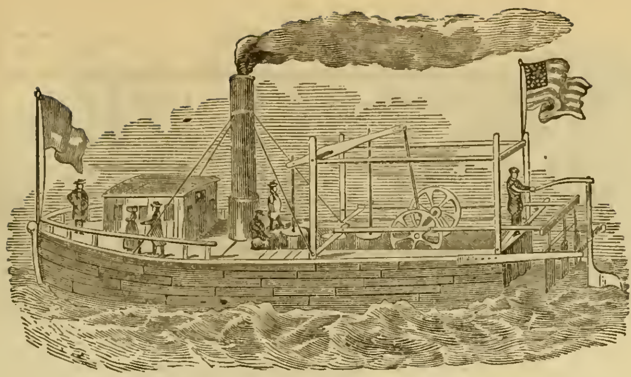
### STEAMBOATS.

In looking over English works upon steam, we cannot help noticing the truth of Dr. Lardner's remarks: "England has been so dazzled by the splendor of her own achievements in the creation of a new art of transport by land and water within the last thirty years, as to become in a measure insensible to all that has been accomplished in the same interval and in the same department of the arts elsewhere." Not content with the praise other nations have ever been willing to give her for the invention of the steam engine, she also wishes to rob John Fitch of the only reward we can now give him for a life devoted to the steamboat. It is true that her arguments are aided to this end by the writings of some Americans who have endeavored to prove Fulton as the first practical steam navigator, thereby putting the date of this invention some twenty years later. But the time is fast approaching when the true inventor will be acknowledged by his countrymen, and the man who prophesied so truly that "this will be the mode of crossing the Atlantic in time, whether I shall bring it to perfection or not; steamboats will be preferred to all other conveyances, and they will be particularly useful in the navigation of the Ohio and the Mississippi. *The day will come when some more potent man will get fame and riches for my invention*" —when this man, we say, will be honored as he should be by the millions who enjoy the fruits of his genius; when our school-books will place his name in connection with that of Fulton, and his biography will be found in every library; when his grave and the tomb of Washington will not bring a blush to the American cheek.

And are you not to blame, reader? Have you ever read the life of John Fitch, the American Watt—a life that remained sealed for thirty years by his own request, and now teaches a lesson of perseverance, under trials that few ever have to encounter? If not, it is a duty you owe your country and yourself to read it at once, and thus add another name to the tablets of your memory, already inscribed with those of Franklin, Fulton, and Morse.

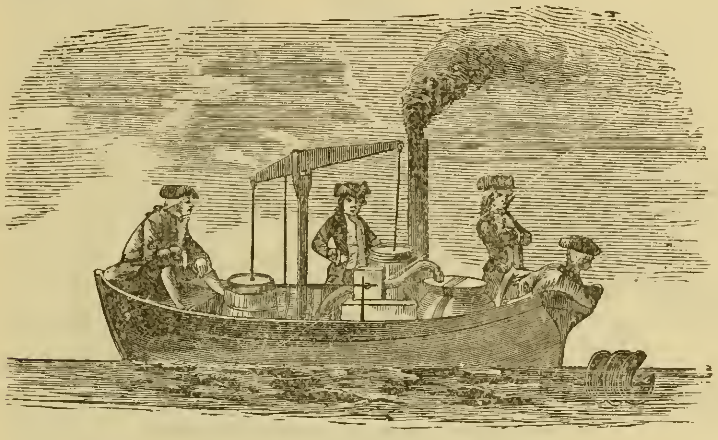
The extent to which steam navigation has improved our country, is scarcely realized even by those who have travelled over it the most. The Hudson river, from the first voyage of the North River, Fulton's steamboat, up to the present time, has remained at the head of all competitors in river navigation. We had then two trips per week, each consuming from thirty to thirty-six hours; we have now four passenger boats per day over the entire route, and many making short trips, besides those used for towing barges and canal boats; the passenger boats making the entire trip of one hundred and fifty miles in from ten to twelve hours. The increased prosperity of New York, growing out of this immense traffic by steamboats alone, is very great, but even this is small when compared with the navigation of the Mississippi and the other western rivers. In 1856 there were over one thousand steamboats and propellers on the western waters, costing not less than nineteen millions of dollars, and of a carrying capacity of four hundred and forty-three thousand tons. Of these boats, the smallest was the Major Darien, of ten tons, built at Freedom in 1852; and the largest was the Eclipse, of one thousand one hundred and seventeen tons, built at New Albany the same year. Thus, on the western waters, in the short space of forty-five years, steam created a business that absorbed nineteen millions of dollars in steamboats alone.

Up to the year 1811, the only regular method of transportation had been by means of flat boats, which consumed three or four months in the passage from New Orleans to Pittsburg. The price of passage was then one hundred and sixty dollars; freight, six dollars and seventy-five cents per hundred pounds. The introduction of steam has reduced the price of passage between these two cities to thirty dollars, and merchandise is carried the whole distance for a price which may be regarded as merely nominal. Besides this great saving of time and money effected by steam navigation on these waters, the comparative safety of steam conveyance is an item which especially deserves our notice. Before the steam dispensation began, travellers and merchants were obliged to trust their lives and property to the bargemen, many of whom were suspected, with very good reason, to be in confederacy with the land robbers who infested the shores of the Ohio, and the pirates who resorted to the islands of the Mississippi. These particulars being understood, we are prepared to estimate the value and importance of the



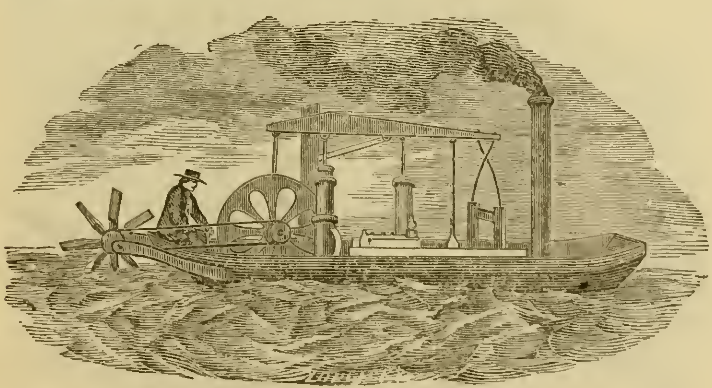
THE FIRST STEAMBOAT EVER BUILT TO CARRY PASSENGERS.

Constructed by John Fitch, and finished April 16th, 1789. Cylinder eighteen inches in diameter, speed eight miles per hour in smooth water. The following year this boat was run to Burlington regularly as a passenger boat.



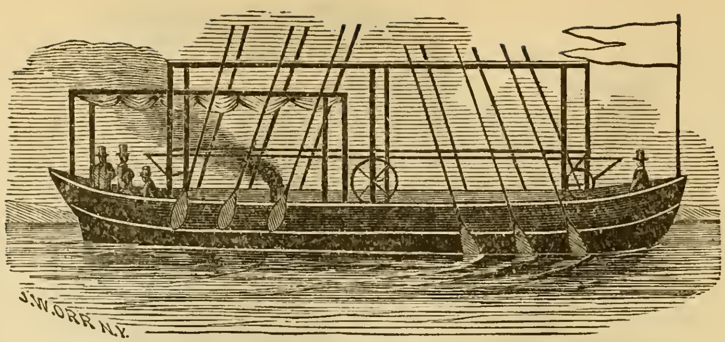
THE FIRST PROPELLER EVER BUILT.

Constructed by John Fitch, and experimented with by him on the Collect pond, New York city. The boiler was a twelve gallon pot, with a bit of truck-plank fastened by an iron bar placed transversely. This was in the year 1796.



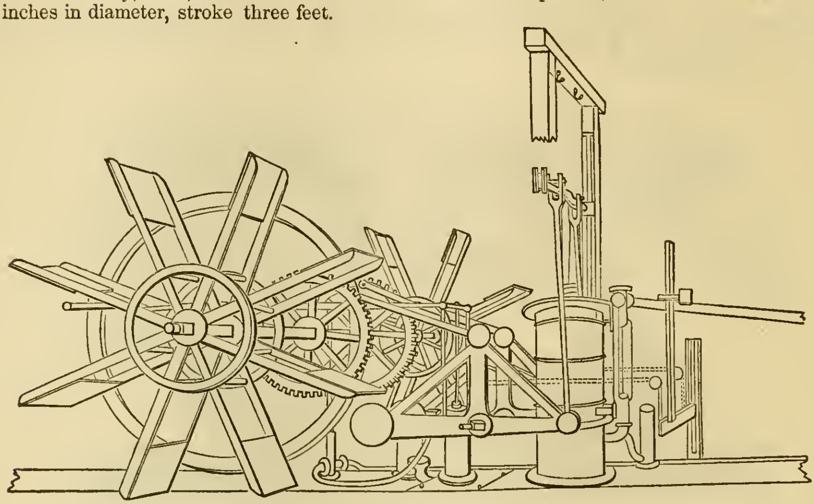
OLIVER EVANS' ORUKTER AMPHIBOLOS.

Thirty feet long and twelve broad. Cylinder five inches in diameter with a nineteen inch stroke. Constructed by Oliver Evans about the year 1804.



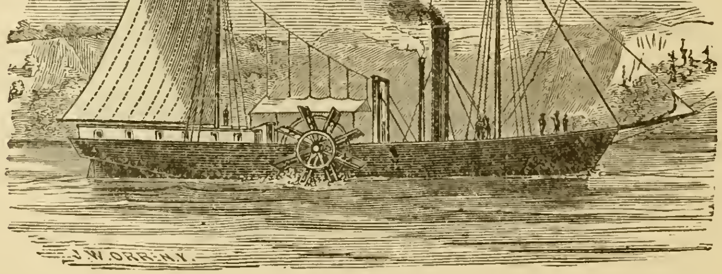

THE SECOND EXPERIMENTAL BOAT OF JOHN FITCH.

Finished in May, 1787, and run at the rate of four miles per hour on the Delaware. Cylinder twelve inches in diameter, stroke three feet.



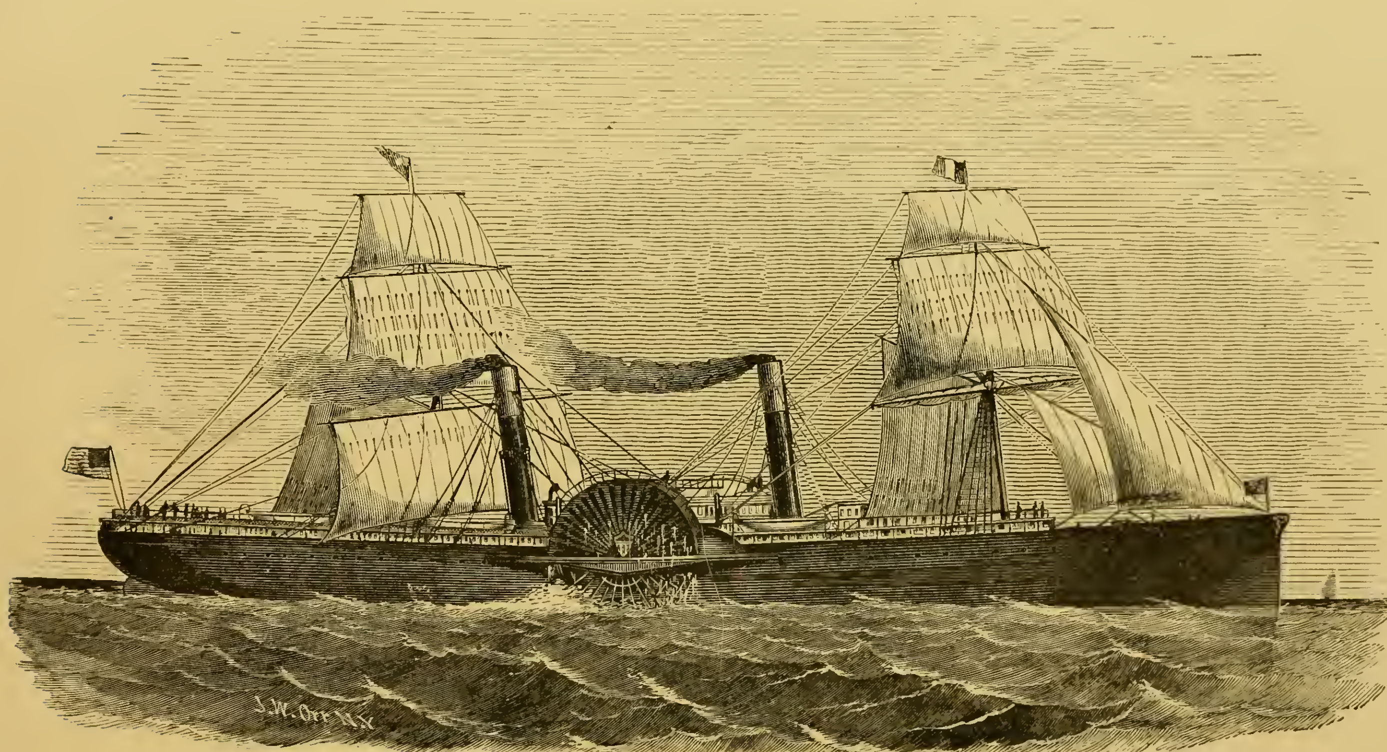
THE MACHINERY OF FULTON'S FIRST STEAMBOAT.

Imported from England where it was constructed in 1805. Wheels fifteen feet in diameter, cylinder twenty-four inches in diameter, four feet stroke.




THE NORTH RIVER, OF CLERMONT.

Robert Fulton's first steamboat as she appeared after being lengthened in 1808. She was launched in 1807, and was run as a regular packet between New York and Albany. Speed four miles per hour, length 133 feet, beam 18 feet, depth 8 feet, tonnage 160.




STEAMER ADRIATIC.

services which the steam engine has rendered to the commerce and prosperity of the western states.

In 1811, Messrs. Fulton and Livingston, having established a ship-yard at Pittsburg for the purpose of introducing steam navigation on the western waters, built an experimental boat for this service—and this was the first steamboat that ever floated on the western rivers. It was furnished with a stern wheel and two masts—for Mr. Fulton believed, at that time, that the occasional use of sails would be indispensable. This first western steamboat was called the Orleans; her capacity was one hundred tons. In the winter of 1812, she made her first trip from Pittsburg to New Orleans in fourteen days.

The first appearance of this vessel on the Ohio river produced, as the reader may suppose, not a little excitement and admiration. A steamboat at that day was, to common observers, as great a wonder as a navigable balloon would be at the present. The banks of the river, in some places, were thronged with spectators, gazing in speechless astonishment at the puffing and smoking phenomenon. The average speed of this boat was only about three miles per hour. Before her ability to move through the water without the assistance of sails or oars had been fully exemplified, comparatively few persons believed that she could possibly be made to answer any purpose of real utility. In fact, she had made several voyages before the general prejudice began to subside, and for some months, many of the river merchants preferred the old mode of transportation, with all its risks, delays, and extra expense, rather than make use of such a contrivance as a steamboat, which, to their apprehensions, appeared too marvellous and miraculous for the business of every-day life. How slow are the masses of mankind to adopt improvements, even when they appear to be most obvious and unquestionable!

The second steamboat of the west, was a diminutive vessel called the Comet. She was rated at twenty-five tons. Daniel D. Smith was the owner, and D. French the builder of this boat. Her machinery was on a plan for which French had obtained a patent in 1809. She went to Louisville in the summer of 1813, and descended to New Orleans in the spring of 1814. She afterward made two voyages to Natchez, and was then sold, taken to pieces, and the engine was put up in a cotton factory. The Vesuvius was the next; she was built by Mr. Fulton, at Pittsburg, for a company, the several members of which resided at New York, Philadelphia, and New Orleans. She sailed under the command of Captain Frank Ogden, for New Orleans, in the spring of 1814. From New Orleans, she started for Louisville, in July of the same year, but was grounded on a sand-bar, seven hundred miles up the Mississippi, where she remained until the 3d of December following, when, being floated off by the tide, she returned to New Orleans. In 1815-16, she made regular trips for several months, from New Orleans to Natchez, under the command of Captain Clement. This gentleman was soon after succeeded by Captain John D. Hart, and while approaching New Orleans, with a valuable cargo on board, she took fire and burned to the water's edge. After being submerged for several months, her hulk was raised and re-fitted. She was afterward in the Louisville trade, and was condemned in 1819.

In 1818, the first steamboat was built for Lake Erie and the upper lakes, at Black Rock, on the Niagara river, for the late Dr. I. B. Stuart, of Albany, N. Y., by Noah Brown, of New York city. She was a very handsome vessel, 360 tons burden, brig rigged, and her engine, on the plan of a Boulton and Watt square engine, was made by Robert McQueen, at the corner of Centre and Duane streets, New York city; her cylinder was 40 inches diameter, 4 feet stroke. The materials for making the boiler were sent from New York, and the boiler was made at Black Rock—9 feet diameter, 24 feet long—a circular boiler, with one return flue, called a kidney flue, seldom, if ever, carrying more than nine inches of steam. This steamer was called the Walk-in-the-Water, after a celebrated Indian chief in Michigan. Her engines were transported from New York to Albany by sloops, and from Albany to Buffalo by large six and eight horse Pennsylvania teams. Some of the engine was delivered in fifteen days time, and some was on the road about twenty-five days.

The trip from Black Rock, or Buffalo, to Detroit, consumed about forty hours in good weather, using thirty-six to forty cords of wood the trip. The price of passage in the main cabin was eighteen dollars; from Buffalo to Erie (Penn.), six dollars; to Cleveland, twelve dollars; to Sandusky (Ohio), fifteen dollars; to Detroit, eighteen dollars. The strength of the rapids at the head of the Niagara river, between Buffalo and Black Rock, was so great, that besides the power of the engine, the steamer had to have the aid of eight yoke of oxen to get her up on to the lake, a distance of about two and one-half miles. In those days, the passenger and freighting business was so small, that one dividend only was made to the owners for the first three years from the earnings of the steamer. In 1821, in the fall, the steamer was totally lost in a terrible gale. On the coming winter, a new steamer was built at Buffalo, by Mr. Noah Brown of New York—a very strong, brig-rigged vessel. She was called the Superior, flush decks fore and aft; the first steamer, the Walk-in-the-Water, having had a high quarter or poop deck.

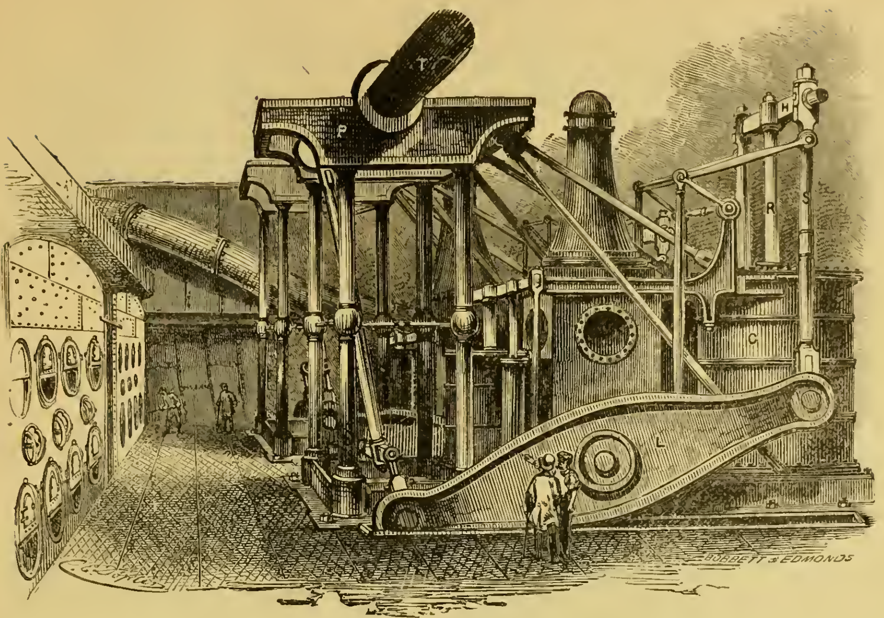
Compare the *time* and *expense* of travelling in those days with the present time! Mr. Calhoun (now living), the engineer of the Walk-in-the-Water, says, "Every two years I used to return to New York from Buffalo in the fall, and in the spring from New York to Buffalo. I have been *three* and *four* days, by stage, to Albany; never less than three days, and sometimes near five days; the stage fare was ten dollars to Albany. From Albany to Buffalo, I have been ten days in getting through; the shortest time was eight days; the stage fare through, was *twenty-one* dollars. *How is it now?* My usual expense in going to Buffalo from Albany was thirty dollars, including meals and sleeping." Such facts show the advantages we have obtained from the use of steam in our river navigation.

The boats that then plied upon the Hudson river, would not be sufficient to carry the passengers' baggage of the present day. The first boat was only 160 tons, while the New World, built in 1847, was of 1400. The latter has made the trip from New York to Albany in seven hours and fifteen minutes, including nine landings of say five minutes each; the actual running time being six hours and twenty minutes; distance, one hundred and fifty miles—performed by the North River in thirty-six hours.

The application of the steam engine to navigation, has been successful by three methods only: the side wheel, the stern wheel, and the propeller. The side wheel was known to the ancients, and was used in connection with a windlass, turned by men, as a means of propulsion, by the Romans, in their war galleys. It was first partially applied to steam navigation by Robert Fulton, but since his day it has undergone vast improvement. As at first constructed, it consisted of a double-spoked water-wheel, suspended by a shaft with no outside bearing, which shaft, being of cast iron, was very liable to break. The outside bearing and guard were subsequently invented by Fulton, as appears from his specification of patent. The wheels being totally uncovered, were found to throw water upon deck, and a dash-board was put up to prevent it, which was in time replaced by the present wheelhouse. The paddle was next surrounded with a circular brace, or rim, as at present in use. In Fulton's first boat, the wheels could, at will, be disconnected from the engine, but this plan went out of use in order to simplify the machinery, after the crank shaft was adopted, connected directly with the engine. Various side wheels have been patented, that are so constructed as to prevent the lift of water as the bucket rises therefrom. One on the Richard Stockton appears to work well, but their complication, cost, and liability to get out of repair, have prevented their general introduction.

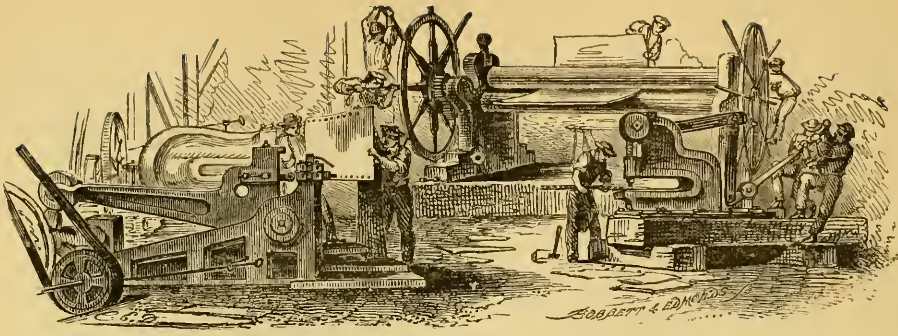
The stern wheel was first thought of by Jonathan Hull, of England, in 1736, as sufficiently appears from drawings thereof published by him; but it certainly was first practically applied by Robert Fulton, in the steamboat Orleans, of which we have already spoken. This wheel is now in almost universal use on our western rivers, as it is peculiarly adapted to boats drawing but little water. The wheel is suspended at the stern, and is sometimes covered with a wheel-house, but more frequently entirely exposed.

The propeller was first applied to a small steamboat built by John Fitch, and experimented with by him under the patronage of Chancellor Livingston, on the Collect Pond in New York. The propeller was a screw or worm. Great improvements have, however, been made in the screw, and to the English we are indebted for some of the most important. Captain Ericsson deserves great credit for his improvements in this respect. The improvements in the screw propellers since 1860, have secured its almost universal use in all sea-going ships, and particularly in war steamers. The new vessels, both armed and unprotected, of the British

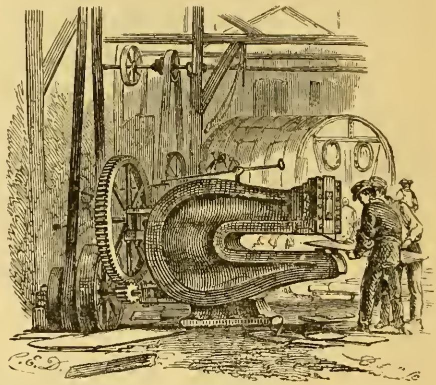


MARINE ENGINE.

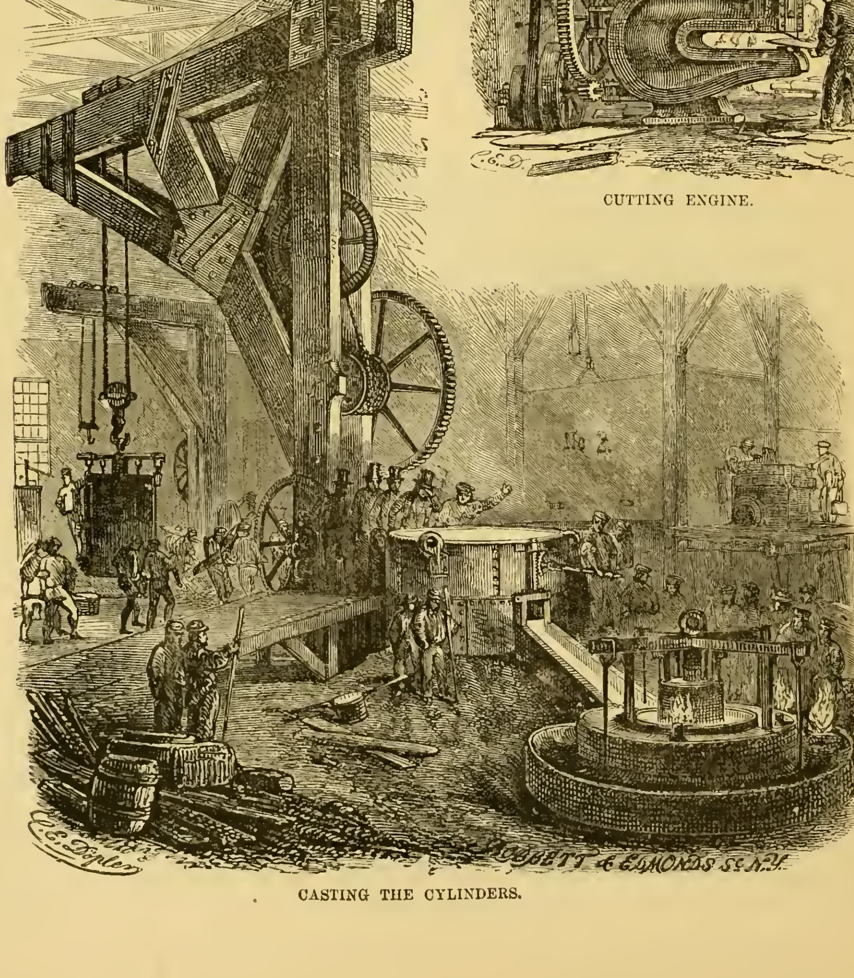
RIVETING THE BOILERS.



BENDING AND CUTTING ENGINES.



CUTTING ENGINE.



CASTING THE CYLINDERS.

and American navies, are all propelled by the screw, and so universal has its use become in the merchant service, that of the ocean steamers now (1870) sailing from the port of New York, somewhat more than 200 in number, but one or two have paddle-wheels. The Pacific mail steamers, the Liverpool and Great Western Steamship Company's ships, and those of the Hamburg and Bremen lines, are fine specimens of the screw steamship, in their roominess, comfort and elegance. It was at first objected to the propellers that they rolled more than the paddle-wheel steamers, and that there was an unpleasant vibration from the rapid revolution of the heavy screw on a shaft extending half the ship's length. They were, also, at first considerably slower than the paddle-wheels. These objections have been almost wholly obviated; the speed of a screw steamer of fine lines is fully equal if not superior to that of the best paddle-wheel. They have repeatedly crossed the Atlantic in a little more than eight days, and by some improvements in construction, both of the ships and the screws, the rolling and the vibration is greatly diminished. The advantages of the propeller were, that in a heavy sea it was always submerged, whatever the condition of the ship's lading, while the paddle-wheels would be out of water on one side or too deep on the other; the paddles were, also, more exposed to danger of breakage, and when the wind was ahead greatly impeded the speed of the ship. The paddle-wheel steamers, also, consumed on an average nearly double the fuel required for the propellers. In war-ships the propeller had the advantage of having its motive power out of harm's way, and of having an unobstructed broadside for firing upon the enemy. The monitors devised by Captain Ericsson, which were propelled by screws, though for the most part intended for coast and harbor defense and offensive warfare only upon forts, &c., demonstrated in the case of the Dictator, Monadnock, and Miantonomoh, that a steamer might be very low in the water, having in fact no appreciable bulwarks, and yet be perfectly sea-worthy, and possess high qualites of speed and ready management in all weathers. The plan of having twin screws, one under each quarter, has been tried in London, by the Messrs. Dudgeon; the steamers turn more readily and in smaller space, but are not materially faster. The adoption of a feathering screw, or one in which the blades can be turned into a line with the ship's keel, is an improvement in auxiliary propellers where the ship depends upon her sails in favorable winds; but these vessels are less numerous now than formerly. The insertion of three or more blades of the screw around the periphery of a hollow sphere, attached to the shaft instead of directly to that shaft itself, (Griffith's screw,) or of the insertion of numerous short blades around the periphery of a ring of metal, (Ericsson's screw,) or of having the blades within the periphery, (Carlsrund and Sorensen's,) or of applying a large proportion of the power nearly parallel to the shaft, by inserting behind the moving screw a fixed screw having the blades turned in the opposite direction, (Rig's,) have each their advantages, and their advocates.

In the so-called cigar steamers of Ross Winans, and some other similar inventions, one part of the design was the operating of two or three propellers in a line with the steamer's keel, one near the bow, another, amidships, and still a third at the stern. The theory was that the first would overcome the resistance, and the others could propel the vessel at much higher speed than ordinary.

The use of the donkey engine or auxiliary pump, has been adopted in nearly all of our steam vessels, and is a decided improvement over the old method of filling the boilers by the main engine, as it obviates the difficulty of working the wheels while lying at the wharf, or stopping from any cause. The Great Eastern was not, at first, supplied with them, but the experience of the great storm in which the monster ship came so near foundering, led to their being introduced at the earliest opportunity. The builder of a steamship who should neglect to furnish donkey engines would now be considered insane.

The use of coal in our steamers is now universal upon the Atlantic coast and rivers. John E. Mowatt, the first to establish the tow-boat business, was also among the first to burn coal. His boat, the Henry Eckford, was fitted up for that purpose, but the want of a sufficient draft was the cause of its abandonment after several trials; this was in 1825. A few years after, Robert L. Stevens tried a blower on his crank boat, the North America. His first blower was of rude construction, being made of planks, and placed directly in front of the furnace, under the doors. After his success, the blower came into general use both for coal and wood; but improvements in furnaces have now, in a measure, superseded its use. Mr. Stevens tried several expensive experiments, and many of them proved of value only as lessons to the engineer. While experimenting upon the blower, he caused to be constructed a spiral fan in the chimney, but abandoned it after one or two trials. Placing the boiler on deck was his invention, as also the false bow that made so great an improvement in speed. The present open work walking-beam is also ascribed to him; in fact we may safely say that Robert L. Stevens did more than any other man toward the improvement of the steam-engine.

In the early days of steamboats on the rivers and lakes, there were great fears entertained both of explosions and of danger from fire. These apprehensions were not altogether groundless. On the western rivers and lakes, where the boats were furnished with high pressure engines, carelessly built, and run with the highest attainable speed, by the use of pitch and other quickly burning fuel, and with prevalent recklessness of human life, explosions were of frequent occurrence, and fires which swept with frightful rapidity through the cargoes of cotton or other combustible materials, took place too often. In the Atlantic states, where the engines were low pressure and the cargoes less inflammable, they were less common. The first destructive explosion was on board the steamboat Washington, near Point Harmar, on the Ohio river, June 9, 1816. A considerable number were killed, and many others scalded and horribly mangled. The Oliver Ellsworth, a steamboat plying on the Connecticut river, exploded on that river in 1818, with great loss of life. We have no list of the number of explosions, or of the burning of American steamboats, but the number must have been several hundred, many of them attended with great loss of life, and terrible suffering. Any one whose memory of the events of the past fifty years is distinct, will recall many of these sad scenes, of some of which he had very probably been an eye-witness. Many of these were inevitable under any precautions which could have been adopted; but others were the result of racing, carelessness, or recklessness of human life. Still, while there have been many unnecessary disasters, the result of ignorance and mismanagement, there can be no question that the transportation by steamboats is much safer and less productive of loss of life, than the old methods of locomotion, by stage, wagon, or on horseback, or even by sailing vessel, canal boat, flat-boat, or barge. The number of accidents at last drew the attention of Congress to the subject, and successive bills were passed to endeavor to control and prevent these serious disasters; but it was not until after several trials that the present very efficient system of inspection was perfected. Since the passage of this act, whose provisions we recite below, the number of these accidents has materially decreased, though we are still occasionally distressed by reports of wholesale slaughter by the explosion or burning of some great steamer with its hundreds of passengers.

Among others to whom great credit is due for their modifications of the steam-engine or some of its parts, Mr. Corliss, of Providence, R. I., of whom we have already spoken; Mr. Learned, of the firm of Lee & Learned, manufacturers of steam fire-engines; Capt. Ericsson; Mr. Dickinson, equally celebrated as an engineer and as a great patent lawyer; Mr. Horatio Allen, and several others, have made valuable improvements in the steam-engine. It is due in a great measure to the valuable modifications which these men have introduced in the use of steam and to the simplification and increased perfection of the mechanism of steam-engines, that among the hundreds of thousands of them in use throughout the United States, so few accidents occur. The engineers employed are too often, especially on stationary engines, unskilled and incompetent for their business; but most of the engines are so well constructed that they will not give out except from the most outrageous carelessness or stupidity in their management.

In the year 1852, an act was passed by Congress, containing provisions against fire, regarding pumps, boats, life-preservers, the transportation of dangerous articles, etc. This act also provided for an inspector of boilers in each district, whose duty it is to test all the boilers in his district, used on board of vessels carrying passengers, once when first constructed, and at least once a year thereafter. The Board of Inspectors were also empowered with the examination of engineers, which duty is set forth in the following section: "Whenever any person claiming to be qualified to perform the duty of engineer upon steamers carrying passengers, shall apply for a certificate, the

Board of Inspectors shall examine the applicant, and the proofs which he produces in support of his claim; and if, upon full consideration, they are satisfied that his character, habits of life, knowledge, and experience in the duties of an engineer are all such as to authorize the belief that the applicant is a suitable and safe person to be entrusted with the powers and duties of such a station, they shall give him a certificate to such effect, for one year, signed by them, in which certificate they shall state the time of the examination, and shall assign the appointee to the appropriate class of engineers."

It was also provided that nine supervising inspectors should be appointed by the executive, to carry out the provisions of the act. Since the passage of this law, steamboat explosions on the Atlantic coast have become almost unknown, and have greatly decreased in the west. With competent inspectors this law is invaluable, and we hope to hail the day when a similar act is passed in every legislature, touching locomotive and stationary boilers.

No one who looks at the immense amount of business done by steam vessels, will question the advantages obtained by the application of steam to navigation, still this branch of commerce is as yet in its infancy, and it is our belief that not only will steam supersede sails entirely, but also that the laborious occupation of rowing will eventually be mainly done by steam. It is unquestionable that boats requiring four men to pull them can, even now, be much more economically worked by machinery, and certainly run much faster. Their cost need not exceed five hundred dollars. For such small craft the propeller is better fitted than the side wheel. There was a boat of this description running in the harbor of Norfolk, for some years, and capable of carrying twelve passengers at eight miles per hour, at the expense of seventy-five cents per day for fuel, and the wages of one man, who could easily do the work and steer the boat. This boat carried passengers to the Great Eastern, when she lay off Old Point Comfort, and appeared like the minnow beside the whale.

In 1864, the Navy Department ordered the construction of several steam launches, small boats of about the dimensions of the Captain's boat of a war steamer, to perform the service which had till then been done by the row-boats. It was on one of these that Lieutenant Cushing ran up to the Albermarle and effected her destruction.

We have already stated that John E. Mowatt was the first to introduce the tug business on the North river. This was Jonathan Hull's idea; he never dreaming that large vessels could be provided with propelling power, both on account of its weight, the weight of fuel for a voyage, and the danger from fire. This branch of steam navigation has proved very lucrative. Within the past few years the propeller has here also been substituted. Philadelphia, we believe, was the pioneer in this enterprise, and most of the propeller-tugs were built in that city. We will conclude this chapter with the following statement of the tonnage of steam vessels belonging to the several ports of the United States in 1868, as published in the "Report on Commerce and Navigation:"—

| | |
|---|---|
| Atlantic and Gulf Coasts | 653,730.37 |
| Pacific Coast | 49,895.98 |
| Northern Lakes | 144,117.15 |
| Western Rivers | 351,671.39 |

The total steam tonnage of the United States, for the year ending 30th of June, 1868, was 1,199,414.89-95 tons.

## CHAPTER III.

### LOCOMOTIVES.

Our second chapter referred more particularly to the application of steam to navigation. In this, we shall endeavor to set forth its advantages in land transportation. Among the earliest experiments upon this subject in America, were those by Oliver Evans, of Philadelphia. The following is his account, published in 1804:—

"I constructed for the Board of Health of Philadelphia a machine for cleaning docks, called the Orukter Amphibolos or Amphibious Digger. It consisted of a heavy flat-bottomed boat, thirty feet long, and twelve feet broad, with a chain of buckets to bring up the mud, and hooks to clear away sticks, stones, and other obstacles. These buckets are wrought by a small steam engine set in the boat, the cylinder of which is five inches diameter, and the length of stroke nineteen inches. This machine was constructed at my shop, one mile and a half from the river Schuylkill, where she was launched.

She sunk nineteen inches, displacing five hundred and fifty-one cubic feet of water, which, at 62.5 pounds, the weight of a cubic foot, gives the weight of the boat thirty-four thousand four hundred and thirty-seven pounds, which, divided by two hundred and thirteen, the weight of a barrel of flour, gives the weight of one hundred and sixty-one barrels of flour that the boat and engine is equal to. Add to this the heavy pieces of timber and wheels used in transporting her, and the number of persons generally in her, will make the whole burden equal to at least two hundred barrels of flour. Yet this small engine moved so great a burden, with a gentle motion, up Market street and around the Centre Square, and we concluded from the experiment that the engine was able to rise any ascent allowed by law on turnpike roads, which is not more than four degrees."

After giving a comparison of the merits of steam and horse power, for moving carriages on common roads, Evans says: "Add to all this that the steam wagon consumes nothing while standing, will roll and mend the roads, while the horse wagons will cut them up. Upon the whole it appears that no competition could exist between the two. The steam wagons would take all the business on the turnpike roads. I have no doubt but you will duly appreciate the importance of such an improvement, and conceive it to be your interest to appropriate the sum necessary to put it in operation. I have invented the only engine that will answer that great purpose, as well as many others for which power may be wanted. It is too much for an individual to put in operation every improvement which he may be able to conceive or invent. I have no doubt that my engines will propel boats against the current of the Mississippi, and wagons on turnpike roads with great profit. I now call upon those whose interest it is, to carry this invention into effect. All which I respectfully submit to your consideration."

Thus it will be seen that Mr. Evans not only practically applied steam to locomotion, but fully realized the advantages of his invention. The introduction of the railroad prevented the improvements that would naturally have followed so great an invention, and but little has since been done, until within the past three or four years.

Mr. Fisher has been one of the most successful in his improvements; his first experiment was in 1853, when he built a small carriage for four persons, which weighed, empty, about one thousand four hundred pounds. The cylinders were ten by four; boiler, thirty feet of surface, only twenty feet of which could be reckoned effective, or one foot of surface to about one hundred and ten pounds of total weight. It outran horses, in night races, on the Broadway pavement, and ran at a moderate speed on cobble pavements, but had not steam enough for common roads.

The next trial was in 1858, on two steam fire engines, the J. C. Cary and J. G. Storm, the carriages and engines of which were built from his design, the boilers and pumps being designed by others. These engines had heavy boilers and apparatus, and could not be regarded as steam carriages, but only as a demonstration of the practicability of working by steam. Their cylinders are fourteen by seven and a half inches; wheels, five feet; the Cary boiler four hundred and eighty feet of heating surface; that of the Storm three hundred and eighty; weight of the Cary, empty, fifteen thousand six hundred and thirty-six pounds; the Storm somewhat lighter. These engines ran well on pavements, and when fairly in motion could run on soft ground at six or seven miles per hour. Mr. J. K. Fisher built another steam carriage, completing it in 1861, from which great results were expected; but the all-engrossing interest of the war, at that time, prevented its receiving attention, and nothing has been heard of it since. A Newark machinist contrived one in which the motive power was an engine and boiler in the form of a man, drawing a wagon, in the front part of which was the water-tank. This excited considerable attention but proved of no practical value. In 1866, a steam wagon with vulcanized rubber ties 13 inches wide and 5 inches thick, was run in the streets of Edinburgh, drawing one or two wagons up the steep grades of that city, and its performance was entirely satisfactory.

The railway itself does not come within the compass of our article; we will state, however, that its origin is unknown, as the remains of a stone tram-road have been found among the ruins of Thebes.

Thirty years ago they were still discussing the advantages of canals as compared with railroads in this country; it is, however, somewhat singular that, with the exception of a mile or two of canal near Cambridge, constructed by the Romans, England had introduced the entire principle of railroads long before she took up canals. As long ago as 1776, and possibly thirty years prior to that time, England had wooden rails in some of her collieries. It was not, however, until the year 1825 that the subject was prominently brought forward. The railway project from Manchester to Liverpool was the cause of this new impulse. The rails, prior to 1776, were of wood, placed about four feet apart on sleepers; these wooden rails were then covered with iron plates, and cast iron wheels were adopted instead of the wooden ones that had been used up to this time. In 1790, the edge rail was invented. From 1802 to 1806, the first effective experiments were made with the locomotive engine. It was not, however, supposed possible that the friction or adherence of the plain wheels of such carriages upon the rail could be sufficient to allow any great weight to be drawn after them, and, therefore, the cumbersome appendage of cog wheels and ratchet wheels, continuous and endless chains, propelling levers, etc., etc., continued to perplex the minds of engineers until about 1814, when it was first discovered that the adhesion of the locomotive carriage, with its plain cast iron wheels, was adequate for every purpose on ordinary railways. The improvement consequent upon this was effected by Mr. Stephenson in the north of England, and for a long time his engines, with unimportant alterations, were used where fuel was cheap. Those locomotives drew about one hundred tons on a level, at four miles the hour, performing the work of about sixteen horses. Their weight was about ten tons, and cost about sixteen thousand dollars.

The first railway in the United States was built from Milton to Quincy, Mass., a distance of two miles, in 1826. The Baltimore and Ohio was the first passenger railroad; it was opened in 1830, a distance of fifteen miles, with horse power. Next in the order of time came the Mohawk and Hudson, from Albany to Schenectady, sixteen miles; opened for travel also with horse power. The first locomotive engine upon a railway in this country, was built at Stourbridge, England, for the Delaware and Hudson Canal Company, and imported by Mr. Horatio Allen. This engine was called the Lion. Mr. Allen, in a speech not long since, gives a graphic account of the first trip: "It was in the year 1828, on the banks of the Lackawaxen, at the commencement of the railroads connecting the canal of the Delaware and Hudson Canal Company with their coal mines; and he who addresses you was the only person on that locomotive. The circumstances which led to my being alone on the engine were these: the road had been built in the summer; the structure was of hemlock timber; the rails of large dimensions, notched on caps placed far apart; the timber had cracked and warped from exposure to the sun. After about three hundred feet of straight line, the road crossed the Lackawaxen creek on trestle-work, about thirty feet high, with a curve of from three hundred and fifty-six to four hundred feet radius. The impression was very general that the iron monster would break down the road, or it would leave the track at the curve and plunge into the creek. My reply to such apprehensions was, that it was too late to consider the probability of such occurrences; that there was no other course than to have a trial made of the strange animal, which had been brought here at great expense; but that it was not necessary that more than one should be involved in its fate; that I would take the first ride alone, and the time would come when I should look back to the incident with great interest. As I placed my hand on the throttle-valve handle, I was undecided whether I would move slowly or with a fair degree of speed; but believing that the road would prove safe, and preferring, if I did go down, to go handsomely, and without any evidence of timidity, I started with considerable velocity, passed the curve over the creek safely, and was soon out of hearing of the vast assemblage. At the end of two or three miles I reversed the valve, and returned without accident; having thus made the first railroad trip by locomotive on the western hemisphere."

The first locomotive engine ever built in the United States, was built at the West Point foundry, New York, under the direction of Samuel Hall, for the South Carolina railroad. This engine blew up shortly after it commenced running, and another was built to replace it. In 1831, the De Witt Clinton was built at the same foundry for the Mohawk and Hudson (New York Central) railroad; this engine weighed four tons; it was run without load at the rate of forty miles per hour. Cylinders, five and a half inches in diameter—stroke, sixteen inches; four coupled wheels, four and a half feet in diameter. The boiler was cylindrical, with a large dome in the centre, and contained some thirty flues. In January of the same year, the Baltimore and Ohio railroad offered four thousand dollars for the best anthracite coal-burning locomotive, weighing three and one half tons, and capable of drawing fifteen tons, fifteen miles per hour on a level, with a steam pressure of not more than a hundred pounds to the square inch. The conditions were filled by an engine built by Phineas Davis, of York, Pa., in June, 1831. This engine had an upright boiler and cylinder. William T. James, of New York, who had already constructed a steam carriage in 1829, finished a locomotive in 1832; this engine was employed on the Harlem railroad, with success, for a time, but was eventually sold to the Baltimore and Ohio road, where it exploded in 1834. This engine was provided with a "spark arrester." In January, 1833, M. W. Baldwin, of Philadelphia, long one of our best locomotive builders, built the Old Ironsides, for the Philadelphia and Germantown Railroad Company. This engine weighed five tons, and was said to have been run at the rate of sixty-two miles per hour. Mr. Baldwin introduced the outside connection engine, thus doing away with the crank axle, and placing the cylinder more under the eye of the engineer.

It would be tedious to follow the construction and alterations in the various locomotives that were built by different manufacturers in the United States. We will, however, mention the most important improvements.

The truck frame, in front of the engine, was first used by Adam Hall, of the West Point foundry, in 1832, on an engine called the Experiment. The four eccentrics were first used by William T. James, on his steam carriage; they were, however, patented by S. H. Long, of Philadelphia, in 1830, and first used on a locomotive in 1833; this was the Black Hawk, built by Long and Norris, of Philadelphia, the founders of the present locomotive shop known as Norris' works. The Norris engines were the first ever exported; this was brought about by the, at that time, extraordinary fact of drawing 19,200 pounds up an incline of three hundred and sixty-nine feet to the mile, the engine weighing but 14,370 pounds; on hearing of which, the Birmingham and Gloucester Railway Company ordered several engines for an incline upon their road, where they performed successfully. Since that time, engines have been exported to England, France, Russia, Germany, Egypt, and Chili. In the latter country all the locomotives are American. The engines forwarded to Egypt, were built by William Mason, of Taunton; and for excellence of workmanship, style, and finish, will compare favorably with any in the world. There are now nearly fifty American locomotives on German roads. Messrs. Winans, of Baltimore, furnished the majority of the locomotives sent to Russia. There are twenty-five manufactories of locomotives in the United States, aside from the repair and manufacturing shops of the great railroad companies. Hinckley and Drury's, afterwards called the Boston Locomotive Works, was established in 1840. The Lowell shop began to build engines in 1835. Rogers, Ketchum & Grosvenor, of Paterson, New Jersey, commenced building in 1837. This shop is still in full operation, under the name of the Rogers Locomotive Works. This shop made several material alterations upon the English type; they enlarged the boiler in proportion to the cylinder, established the link motion, and covered more effectually the cylinders and valve chests, to prevent radiation. Rogers, also, was among the first to adopt the full-stroke pump. The locomotives built at this shop have always found a ready market. Next in order was the Taunton Locomotive Company, established in 1847, by W. W. Fairbanks, a marine boiler maker from Providence, Rhode Island. Then John Souther, formerly of Hinckley's shop, started his works in South Boston, in 1848. In 1849, the Amoskeag Manufacturing Company entered the lists with some important improvements; they were followed by the Portland, Lawrence, and Wilmarth shops, and a few years after, by Mason, of Taunton, the East Bridgewater, and the Manchester locomotive works. After 1857, the New England locomotive shops turned their attention largely to other work. One large company failed; others manufactured steam fire-engines, stationary engines, and cotton and woolen machinery; a number became manufactories of cannon and fire-arms during the war, and much of the business fell into the hands of the Paterson and Philadelphia shops. The causes of this change are various: prominent among them may be mentioned the manufacture of locomo tives by the larger railroad companies themselves, at their repair shops.

The manufacture of the locomotive engine had a good effect upon our machine shops, independent of the work it furnished; as in order te construct them a variety of improved tools were made, that have greatly added to the facility for turning out other machinery. These improvements are so marked that no one who is familiar with the machine shop can help noticing them.

Coal is now rapidly superseding wood as fuel for the locomotive. It is true that some of our first engines were coal-burners, but wood has been for years the principal fuel used. The American engine has several marked distinctions from the English; what most strikes the eye of the common observer is the *cab*, or house for the protection of the engineer; this is peculiar to our locomotive. The *smoke stack* is also very different in the wood-burning engine from that in use on coal-burners. The auxiliary pump is used on some of our engines, but not to so great an extent as it should be.

A first-class locomotive engine costs from 10 to 15 thousand dollars, and an average, taken from our largest roads, shows a cost of about sixteen hundred dollars per year for repairs. Locomotives in this country are built much too large for the work they have to accomplish, and the attention of our master machinists having lately been much attracted to this subject, it is to be hoped that some improvements in the weight will be made. A locomotive too heavy for the work it has to do, is not only more expensive in first cost, but in the greater wear of the road. A good locomotive can draw thirty times its own weight on a level, and a paying load should not exceed twenty-five tons; bearing this in mind, why build twenty-six ton engines? There are many parts of an engine now built much too heavy; the bell, dome-casings, and cabs, for instance. It is not necessary to greatly lessen the weight of the running gear, although in some instances this is much too heavy. Wrought iron in place of cast in some cases would be lighter and much better, and steel should be substituted for iron wherever possible. The speed over the American roads is not so great as in England, from the fact that the former have more and steeper grades, and have, besides, shorter curves, to say nothing about their construction being much less expensive. Sixty miles per hour has been made upon our roads, however, but thirty is nearer an average, while in England seventy miles has frequently been attained.

Dr. Lardner, in his lately published "Economy of Railroads," thus endeavors to convey to the unpractised reader the enormous speed of a locomotive going at the rate of seventy miles an hour: "Seventy miles an hour is, in round numbers, one hundred and five feet per second, that is a motion in virtue of which a passenger is carried over thirty-five yards between the beats of a common clock. Two objects near him, a yard asunder, pass by his eye in the thirty-fifth part of a second; and if thirty-five stakes were erected by the side of the road, one yard asunder, the whole would pass his eye between two beats of a clock; if they had any strong color, such as red, they would appear a continuous flash of red. At such a speed, therefore, the objects on the side of the road are not distinguishable. When two trains, having this speed, pass each other, the relative velocity will be double this, or seventy yards per second; and if one of the trains were seventy yards long, it would flash by in a single second. To accomplish this, supposing the driving wheels seven feet in diameter, the piston must change its direction in the cylinder ten times in a second. But there are two cylinders, and the mechanism is so regulated that the discharges of steam are alternate. There are, therefore, twenty discharges of steam per second, at equal intervals; and thus these twenty puffs divide a second into twenty equal parts, each puff having the twentieth of a second between it and that which precedes and follows it. The ear, like the eye, is limited in the rapidity of its sensations, and sensitive as that organ is, it is not capable of distinguishing monotonous sounds which succeed each other at intervals of the twentieth part of a second. According to the experiments of Dr. Hutton, the flight of a cannon ball was six thousand seven hundred feet in one quarter of a minute, equal to five miles per minute, or three hundred miles per hour. It follows, therefore, that a railway train, going at the rate of seventy-five miles per hour, has the velocity of one-fourth that of a cannon ball; and the momentum of such a mass, moving at such a speed. is equivalent to the aggregate force of a number of cannon balls equal to one-fourth of its own weight."

Some years ago a curious calculation,

showing one of the advantages of the steam locomotive, was made in England. "In 1853, 111,000,000 passengers were conveyed, each passenger travelling an average of twelve miles. Twelve miles of railroad are accomplished in half an hour, whereas the old stage coach required an hour and a half to get through the distance. The aggregate time thus saved for the above number of passengers is equal to *thirty-eight thousand* years." This was seventeen years ago, since which time the number of passengers carried has been nearly tripled.

Mr. Fleming, on the Mobile & Ohio railroad, and some other master mechanics, have adopted the plan of paying the engineers a certain fixed salary, and then giving prizes to those who saved the most fuel to the mile run. It is also customary to place the inspection of wood to be used under the engineer's care, he having the choice of the stations at which he will take in wood. With these two regulations the company get better wood at the same price, as it is directly to the engineer's interest to carefully examine the quality, quantity, and price of every load of wood he takes on. So great has been the economy of this plan, that it is strange that every one does not adopt it.

Another important item in the running expenses of the locomotive is the oil and waste. The latter is used to wipe the machinery, not only on account of the looks, but to prevent its *gumming* up with oil and dirt. The average cost of oil, waste, and tallow, taken from some of our largest roads, is seventy-five hundredths of a cent per mile run; and as engines average some fifteen thousand miles per year, we have a total cost, in these small items, of $1,125,000 per year in the United States alone, by the more than 10,000 locomotives now in use.

Before leaving the subject of steam locomotives, we wish to speak of the Dummy engine, or steam car for city railroads. We know that this use of steam has met with great opposition from all classes of men; but what are the arguments? In the first place they say: "Oh! the steam car is much more dangerous than horses." Why? "Because it is more difficult to stop, and it goes so much faster." What is the truth? It is much easier to stop a steam car than one drawn by horses, inasmuch as we have not only the same brakes, but the power of reversing the engine in an emergency. As to the cars being run faster, our laws against fast driving are as potent in the one case as in the other; and by Darker's arrangement, it is impossible for the car to go over a given speed—the governor being attached to the brake. The second argument against steam cars is that the noise and smoke will frighten horses. The noise and smoke can both be avoided, and it has been proved that horses are not more liable to start than at the sight of a buffalo robe. The argument as to expense has been entirely thrown aside; still, but few know the great advantage in this respect that steam has over horse power. A number of our lines average seven horses to a car (in Boston they average eight), in order to have the necessary relays; seven good horses for this purpose are worth, say, eight hundred dollars; the feed, care, and stable-room of each horse averages, say three dollars and fifty cents per week; so that a line with forty cars is under the enormous annual expense, for horse-care and keep alone, of $50,960! Now then for steam. The first cost of an engine and steam generator, with all the necessary appurtenances, will be no more, if as much, as the seven horses to each car. Keeping the engine in repair would incur no more expense than shoeing horses, renewing harness, etc. It would cost no more to replace them than to replace worn-out horses. The engines, to be of sufficient capacity to overcome our steepest grades, will consume eight bushels of coke per day (a high estimate), running sixteen hours, the price of which at present is five cents per bushel; but, supposing the extra demand to cause an advance of a hundred per cent.—which is hardly likely, for even a less increase in price would cause many private families and others to cease using it—the fuel expense in one year, to a company with forty cars, would be $9,984; making the difference in cost, in one year, between steam and horses, of $40,976. Think of it! $40,976 saved to a company with forty cars, in one year (over $1,000 per car), after putting down the fuel at double its present price. Coke is preferable, because it is clean to handle, ignites quick, emits no smoke, is light and cheap, and requires a much less draught than coal. To save cumbrous and useless weight as much as possible, it is proposed to carry very little fuel, except what is on the fire, nor unnecessary extra water either, the tank and bin to be replenished at the depot each trip, while waiting its time.

Were the different companies to offer, as an inducement, to reduce the fare to *four cents*, on condition that the community would permit the use of steam, they would annihilate all groundless opposition on the part of the masses, which is every thing with us; and the enormous increase of "short rides," occasioned by the reduction of fare, would make the receipts greater than at present; and as the saving in favor of steam is quite $1,000 a year per car, the value of the stock would be increased prodigiously. It would seem that there was no valid objection to the use of some forms of dummy engines for city railroads, for they are more completely under the control of the engineer than a horse is under his driver; yet the prejudice is very strong against them, and the South Side railroad of Long Island, after trying them for a year in Brooklyn, E. D., was compelled, in 1870, by the opposition of the people, to withdraw them.

Among the plans for city cars that have been suggested and built, we may mention those of Latta, of Cincinnati; Baldwin, Grice & Long, and Darker, of Philadelphia. Latta's engine was in a separate car from the passengers; Baldwin's had its machinery beneath the car, and its boiler in front; and Darker placed his entire engine and boiler upon the roof, connecting with the wheels on the outside, near the centre. Grice & Long's car was thus fitted: The engines and boiler are on the front platform; the engines slightly inclined, and graded to the front axle; the axle being placed at the extreme end of the car, for the purpose of making the connection, and increasing the stability of the wheels. The boiler was of the ordinary vertical, tubular type; the after part of the car was finished with a self-adjusting, vibrating truck, for the purpose of turning the short curves of city roads.

On roads running through sparsely settled districts, in the suburbs of our great cities, or to villages a few miles distant, these dummy engines often do good service, producing less trouble and annoyance, and proving less dangerous than the ordinary locomotive, but the best form of motive power for driving one or more cars along the streets of a large and crowded city, without inducing serious accidents, is yet to be devised. Something is imperatively needed to take the place of horses for this work, for there is a very general complaint that horses are too slow, and that too much time is consumed in going from one part of the city or its suburbs to another. Whether this difficulty can be obviated by any means of transportation passing along the present level of the streets, is doubtful; and of late, attention has been turned in New York and some other large cities, to other means of locomotion. These, so far as yet proposed, are the following: 1st, an elevated railway sustained on pillars rising from the curb, the cars drawn by endless chains set in motion by stationary engines, placed below the pavement. This plan has been tried, but has met with several accidents, which have created a popular distrust of it; 2d, an elevated railway passing through the middle of the blocks, crossing the streets upon high and strong bridges, and running elsewhere on masonry and tressels of sufficient strength to prevent danger, and drawn by ordinary or dummy locomotives; 3d, an underground railway with openings and stairways at every three or four blocks, in New York, passing under Broadway or the Bowery, and having laterals running in connection with it; 4th, the Arcade railway plan, occupying the entire width of the present principal street, (Broadway, for instance, in New York,) but at the level of the present basements, and covered over above with Hyatt's patent illuminator, or some other mode of illumination, strong enough to permit travel, except of railroads or omnibuses, at the present level of the street; and with elegant sidewalks the whole distance, for foot passengers; 5th, the pneumatic tubular railway, either elevated or underground, in which the cars are driven with great speed through a tube by means of compressed air. One form of this pneumatic tubular railway proposes to have a gigantic wooden tube made air-tight by the cement used for preventing leakage in petroleum barrels, and elevated on tressels; through this tube the cars are to be driven by compressed air at a speed of a hundred miles an hour. The cost is stated as about $10,000 per mile. By some of these means, it is claimed that the speed of transit can be greatly increased without danger, either to the passengers or others, and points now distant can be brought practically very near to each other.

We will conclude this chapter with an anecdote of the first engine introduced upon the Baltimore and Susquehanna railroad. This road was built to run with horses, and in some of the first circulars issued by the company, the road was spoken of as being delightfully picturesque, winding among beautiful scenery, and forming a most interesting ride—rather different from the emperor of Russia's idea of a railroad, which he laid out with a ruler, by describing a straight line from Moscow to St. Petersburg. Against the wish of the president of the company an engine was imported from England in the brig Herald, about the year 1830, and was put upon the road under the management of an English engineer. While standing upon the track one day, fired up and ready to start, the president, who was absent on her arrival, came down to look at the strange animal. He was accompanied by one of the directors, who had already examined the iron steed and was desirous of exhibiting it to the best advantage. The engineer being temporarily absent, the two mounted upon the platform. "Thee sees, friend," said the director, "this lever; well, by drawing it toward thee (suiting the action to the word), the machine will retreat, and by pushing it from thee, it will advance; thus the competent man can handle it as readily as thee can drive a horse. If thee turns this little crank the steam will commence working, and the engine will start." And sure enough the engine did start, for the honest Quaker, in order fully to explain its action, had opened the throttle. Away went the iron horse, affrighting them out of all presence of mind, and increasing in velocity at each stroke of the piston, until it reached one of the picturesque curves that had so much delighted the president, where, with one bound, it left the track and turned a summersault down the embankment. Both parties were hurt, but most fortunately escaped with their lives.

## CHAPTER IV.

### STATIONARY ENGINES.

This is the oldest form, being but a modification of the first steam pumping engines; not being confined to space as in the locomotive and marine engine, these machines have admitted of a greater variation of form, and a better chance of artistic display than any other, consequently we have many instances of elaborate workmanship and a great variety of design. The majority of stationary engines in use may be divided as follows: the beam, the horizontal, the steeple, the oscillating, and the rotary engine. The beam engines are commonly low-pressure or condensing, and are mainly used for pumping, or where great power is required; the motion of the piston is communicated by the working-beam to the pump or crank-shaft at the opposite side of the machine. The horizontal engine is probably the most used at a high pressure in this country; its advantage is the facility with which it is put up, and its steady working; every part being firmly attached to a solid bed, requiring but little bracing to keep it in place. The disadvantage of a horizontal engine is the unequal wear of the cylinder, due to the gravity of the piston. The steeple or vertical engine has, like the beam engine, an upright cylinder, but is connected directly to the main shaft above or below. In all the above-named engines the cylinder is stationary, and the reciprocating motion is changed into rotary by means of a cross-head, slides, and connecting-rod; in the oscillating engine the cylinder vibrates upon trunions, placed sometimes at its centre, and sometimes at its end; thus allowing the piston to be coupled to the crank, and doing away with the cross-head and slides. The advantages of this engine are its reduced size and expense. In the horizontal and other engines the steam valve is moved by an eccentric, but in some oscillators the trunion box forms a self-working valve both for induction at the one side and eduction at the other. The disadvantages of an oscillator are the liability to overheat its trunions and the difficulty of keeping them tight. An oscillator costs less at the start, but requires more oil, and is of doubtful economy.

The change of the reciprocating into the rotary motion was a problem for many years, and the idea that there was a great loss of momentum in the constant stopping and starting of the piston at each end of the stroke induced many mechanics to study some method of obtaining a direct rotary motion, or, in other words, to produce a rotary piston. It was at once evident to the merest novice that a rotary engine would be in reality a rotary pump reversed, and consequently the rotary engines bear so strong a resemblance to the oldest rotary pump as to instantly strike the eye of any one who has seen the two. One of the most successful rotary engines of to-day is that of Holly, of Seneca Falls, New York, and this is only a modification of Murdoch's rotary

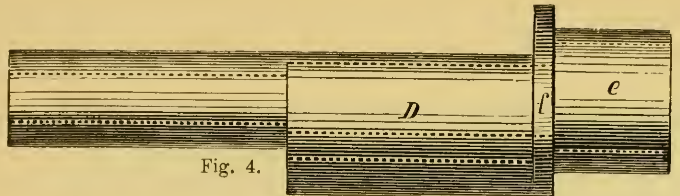



Fig. 4.

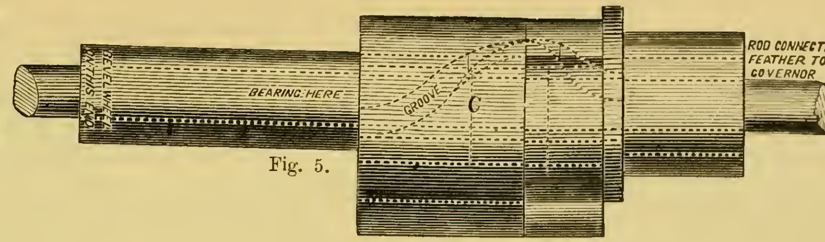



Fig. 5.

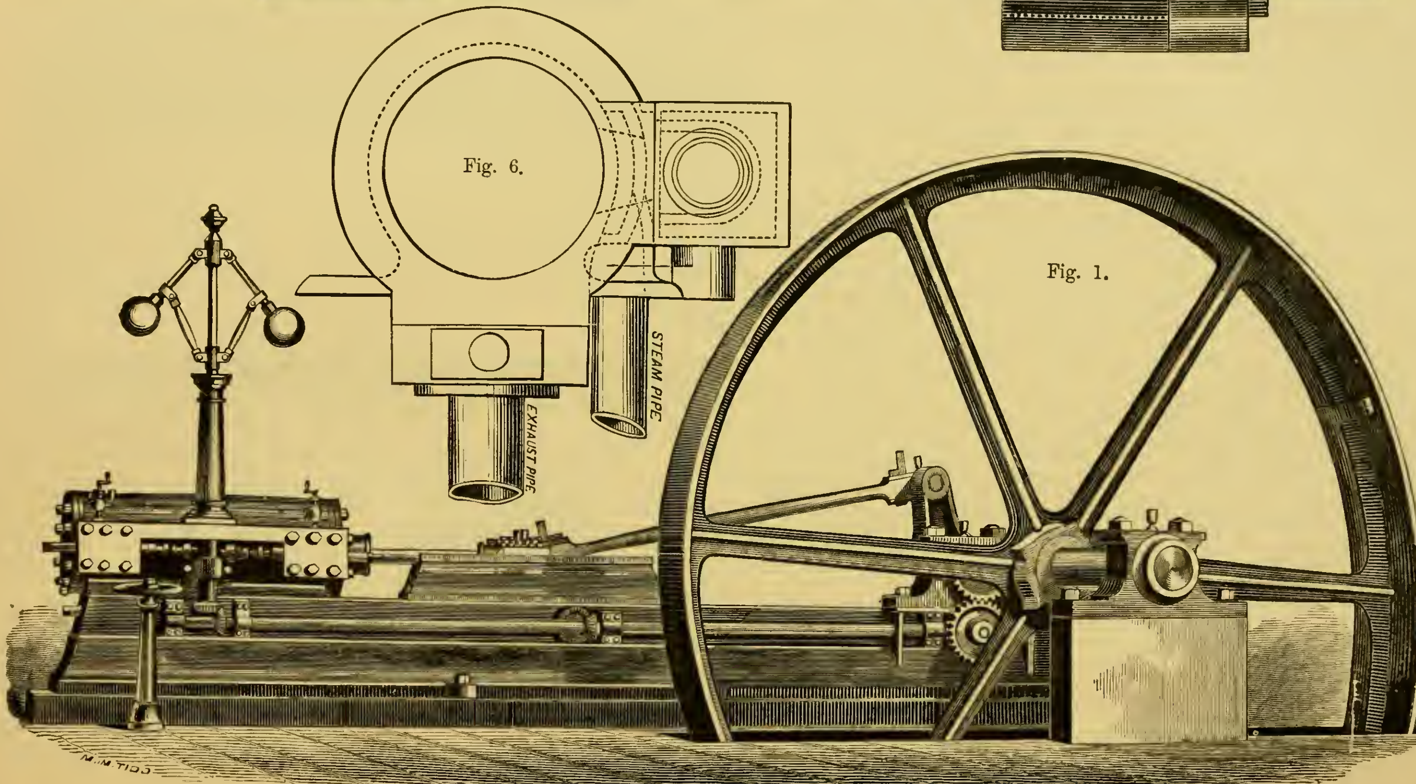



Fig. 6.

Fig. 1.

The Cut, Fig. 1, and the series to Fig. 6, represent one of our high pressure Engines, which, regarded either as a specimen of workmanship, or as an economical and effective source of power, is one of the best in use.

These details, Figs. 1, 2, 3 and 6, being similar to those of other engines, need no special notice; but the Cam, marked (C), Fig. 5, requires particular attention, as it embodies a beautiful and simple device for cutting off steam with certainty at any part of the stroke, the motion being produced automatically by the action of the governor upon this cam, throwing it more or less out of center with the spindle of the governor as the rotation of the balls is less or more rapid, the eccentricity of the cam determining the amount of steam admitted to the working cylinder of the engine. To produce this effect, the cam is made of two pieces. (C) is a hollow cylinder or shell, with a part of one end formed into a cam proper. Throughout the whole length of this piece upon the inside, there is a spiral groove cut to receive one end of a feather, by which its pitch or eccentricity is regulated.

The inside piece (D) is a hub, which exactly fits in the hollow of the cylinder (C), and has a socket (*e*) into which the spindle of the governor is screwed, the other end (*d*) forming a journal or bearing, with a bevel wheel on its extremity, to convey motion from the crank shaft gearing to the governor and cut-off. There is a hole throughout the length of the inside piece (D), which is continued through the spindle of the governor, and which contains the rod that connects the cam with the governor. This hole is eccentric to the outside surface of (D), as well as (C), but is concentric with the collar (*f*) and with the governor rod.

Both pieces, (C) and (D), are connected together by a feather, one piece of which is of a spiral form, and the other is a straight or rectangular piece, the two being connected together by a stub on the rectangular piece, which fits into a hole or bearing in the other or spiral piece, so that the latter can turn on the stub and accommodate itself to the groove in which it has to work. The spiral part of the feather works in a spiral groove in the inside of the shell (C), and the rectangular piece works in a straight groove in the inside of the hub (D), the inner part of the rectangular piece being fastened to the governor rod, so that the feather is permanently connected with the governor.

When the several pieces are put together, the cam is complete as shown in Fig. 5, and it operates as follows: Motion is communicated by gearing from the crank shaft to the bevel wheel on the end of the piece (D), and is communicated to the spindle of the governor, which is screwed into the socket on (D), as the balls rise or fall through change of centrifugal force due to the variation in the speed of rotation. They raise or depress the governor rod, which passes through the spindle and the piece (D), and is attached to the feather, thereby raising or depressing the feather, which, acting on the spiral groove, instantly alters the lift of the cam, and so regulates the amount of steam admitted to the cylinder. Consequently, any speed may be selected at which the load of the engine is to move, and any variation from that will be instantly felt by the governor and corrected by this simple and beautiful device. There is no jar in the working of the parts; the feather moves noiselessly in its grooves; the governor rod moves up and down through the spindle and the piece (D), and can be regulated by hand to give any required opening of the steam ports to suit the work to be done. Any change in the amount of work will then alter the speed of the engine, and so affect the governor and cam as before said.

It is unnecessary to insist on the great economy attained by using steam with a well-regulated cut-off, for practical men know now that the essential points of excellence in the steam-engine, are a good boiler, which generates the greatest quantity of steam for the least consumption of fuel; and, secondly, a reliable cut-off, which uses the steam to the best advantage by admitting the proper quantity for the work required.

Fig. 2.

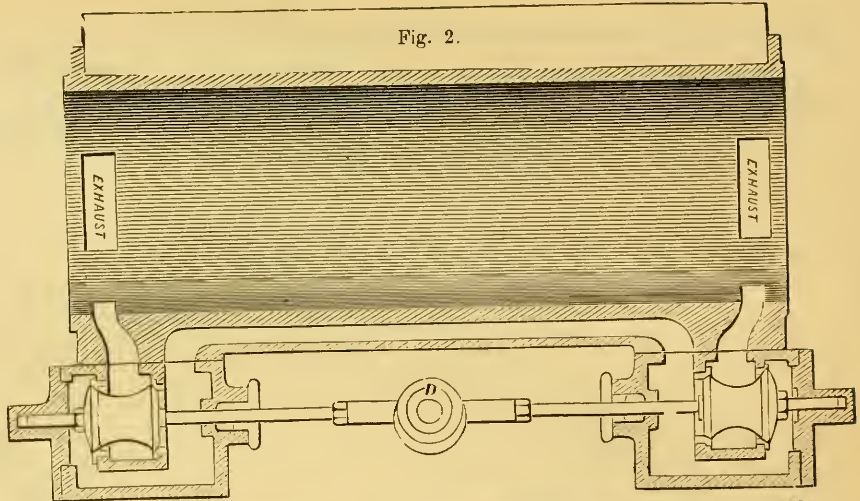
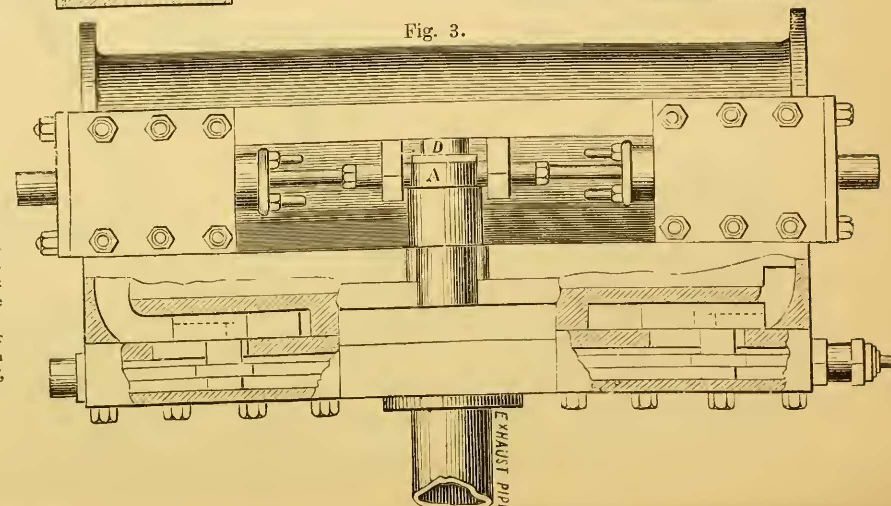



Fig. 3.



engine, which is, in turn, a perfect copy of an old pump taken from Serviere's collection. It may be thus described: two cog-wheels fitted accurately to each other are inclosed in a case; each cog is grooved and fitted with packing, bringing it into steam-tight contact with the circumference and sides of the case. The axles of the cog-wheels are continued through the sides of the case, and geared together at each end to prevent friction upon the centre cogs; now, if revolved, each cog will act as a piston, but as the cogs in contact in the centre lap each other, the piston surface at each extreme of the case will be just double that of the centre, and this surplus of force gives motion to the two axles. The pump of which this engine is a copy was invented as long ago as the sixteenth century.

A patent was obtained in England in 1825 by Mr. J. Eve, an American. Within a cylindrical case a hollow drum was so constructed as to fit closely to the case; floats, or pistons, were cast upon its periphery, and packed to fit the cylinder; on one side of the main cylinder was a small recess filled with a small drum, that revolved in contact with the main drum, this small drum having a segment removed to receive each piston as it passed, and having its diameter so proportioned to the main drum as to revolve once between the passage of each piston or float. Other rotary engines, on a plan analogous to the above, differing only in the manner of opening the valve, have been invented, and copied from the ancients, some of which are exceedingly complicated, but they have always been unsuccessful in practice, principally from the fact that it is exceedingly difficult to pack them. If they could overcome this fault without adding friction, the rotary engine would be very valuable on account of the small space it occupies.

The demand for stationary engines, from one horse power upward, during the last twenty-five years, has been so great that now almost any machine shop is prepared to build them, and of course, while such is the case, thousands of engines are annually built that would better bear the name of steam eaters than steam engines. In some of the small engines that flood the market, the first principles of steam are practically ignored, and there are at this moment running in the United States engines that consume more coal to do the work of ten horses than a properly-constructed one would use to do the work of twenty. As an instance of the truth of this statement, we will take the engines built by Messrs. Corliss & Nightengale, of Providence, over an engine that was working to good advantage in the James Mills, Newburyport, but was removed on the representation of the builders of the new machine, that they would take five times the saving of the first year's fuel as sole payment of their engine. The James Steam Mills contained 17,024 spindles, and, including the weaving and all the preparations for making sheeting and shirtings, required a hundred and ninety horse power; their engines were condensers; cylinders, twenty-four inches by four feet length of stroke. Ten thousand four hundred and eighty-three pounds of coal per day was the average amount used during five years previous to the contract for the new engines; this included the coal used for dressing, heating, and all other purposes for which steam is used in such an establishment. The new engines were high-pressure cylinders, eighteen inches by four feet stroke. By the terms of contract under which the change of engines was made, it was at the option of the company to pay for the new arrangement the sum of ten thousand five hundred dollars cash in lieu of the saving of coal; but the choice was to be made before the new engines were put in operation. In view of the favorable results obtained by the former engines, they decided to pay in the saving of fuel. The new engines were run one year from December 3d, 1855, and the average amount of coal used per day was found to be five thousand six hundred and ninety pounds. The coal being reckoned at six dollars per ton, Messrs. Corliss & Nightengale received nineteen thousand seven hundred and thirty-four dollars and twenty-two cents. Thus it will be seen that the builders received nearly double price for their engine, and yet it cost the owners of the mill nothing for a machine that was destined to be a source of great saving in their future expenses.

The singular character of Mr. Corliss' bargains attracted much attention to his engines, as they showed conclusively the advantages thereof over the old plans. The above experiment was a comparison between his engine and what had been considered a good machine; in the following, however, we see its great advantages over a more ordinary engine. In March, 1852, Mr. Corliss contracted with Crocker Brothers & Co., of Taunton, Massachusetts, to furnish them with an engine that would do the same work they were then doing with five tons of coal per day, and yet only consume two; agreeing to forfeit one dollar per pound, for every pound per day used above that amount. This contract was successfully filled without taking out the old boilers.

Mr. Corliss' engines possessed, as may be readily supposed, several important improvements, one of which was the manner by which its speed was regulated. Watt regulated by connecting the governor with the throttle-valve; Corliss used no throttle-valve, but connected the governor direct to the cut-off. This connection of the governor was not of itself the improvement of Mr. Corliss, as that had already been done by others; but it was the manner by which this connection was made, which was at once simple and efficacious, for which he deserves credit. The use of the throttle-valve was always attended with a wire-drawing of the steam. This wire-drawing is a reduction of the expansive force of the steam, and is always attended with more or less condensation; so that every form of cut-off, used with a throttle, is more or less imperfect. By thus dispensing with the throttle-valve altogether, and opening the steam-valve suddenly, the pressure of steam in the cylinder approximates very closely to the boiler pressure. The valves in the Corliss engine are circular; and by his automatic method of varying the point of cut-off, he gains a great advantage, as he cuts off suddenly without danger of slamming, as in the use of the puppet-valve.

The Corliss engines are manufacturea with extreme care; and Mr. Corliss, in 1869, received the great Rumford medal for the greatest improvement in the construction of steam-engines; a medal which has been awarded but twice in more than sixty years. When we add the fact that one-half of the stationary engines in the United States are run by boys or men not capable of managing a modern cooking-stove, the reader can realize to some extent the economy of cheap (?) engines and cheap (?) engineers. Steam is a good slave but a bad master; and the fearful loss of life in the United States during the past forty years, from the explosion of steam boilers, is mainly due to bad management. Boilers are in constant use all over the country, carrying a pressure double—nay, triple—that for which they were intended; the safety (?) valve weighted down by old pieces of iron, stones, etc., to such an extent that the *runner* no more knows what pressure he is using, than does the stranger who is passing his door. In thousands of cases the steam-gauge, which, at least, gives the pressure when in order, is not used, or never tested; and what was intended as a preventive, becomes, by a stoppage in the connecting pipe or a derangement of its machinery, a source of treacherous security. Many a man, on being asked why he does not use a steam-gauge, will reply that they are not reliable, or that the safety-valve is good enough; and yet that same man is perhaps employing an engineer that could not calculate, to save his life, the amount of pressure he was carrying, or, the size of his safety-valve being given, tell its area in square inches. "We can point out places where the engines, beautifully designed and executed in their details, are nothing but a mass of slime and grease from bed-plate to cylinder-head, the deposit of no one knows how many weeks of inattention and neglect, while a stolid *runner* sits calmly by, as though rather admiring the state of things than otherwise. When such is the case where every thing is visible, where is the necessity of looking among the usually unsearched portions of the machine for safety and economy."

One of these steam boilers blew up in Brooklyn, in 1859, and Mr. J. C. Merriam, a scientific practical engineer, was sent for to examine it. He found that in this case, as in many others, the engineer did not understand his business, as was sufficiently evident from the following reasons: his pump was small, but sufficiently large if in good order—which it certainly was not; he took out the piston with ease, and put it back again readily, although it was entirely covered with the coarse gravel and sand thrown about by the explosion. The safety-valve was held in its place by a rod passing through a plate; this rod, originally a good fit, was so firmly rusted in its place, that all the force he could exert on the end of the lever was not sufficient to move it. He unscrewed this plate, and it required two or three smart blows of the hammer to drive the rod out. In his opinion, it would have taken not less than twelve hundred pounds in the boiler to have started that valve, allowing that it had the weight upon it that he saw. The owner stated that the valve always leaked more or less; but on looking at it he was convinced that if it rested upon its seat, it never could have leaked, as it was a ground joint and a good one. He consequently came to the conclusion that the valve was not held in its place by the weight on the lever, but simply by the rust on the valve-rod or stem, the weight at the end having nothing to do with it. The safety-valve was bolted on to the steam dome with four 5-8 bolts, and was evidently blown off at the same instant as the flue collapsed, as it was found in the shop near the engine, while the boiler was thrown at least seventy-five feet against a house.

We might name scores of other accidents resulting from similar causes, of which the above is a fair sample; but it is evident enough, from what we have already said, that there is a want in the community yet unfilled—one that should receive the careful attention of every public man. What we need is a law compelling the owners of steam boilers to have them inspected at least once a year, and properly provided with *safety*-valves and other trustworthy appliances; it also should be imperatively their duty to employ *engineers*, and not mere runners. A law framed upon the United States steamboat inspection plan would be of incalculable benefit to the owners themselves, as well as the community at large.

The gradual introduction of the stationary engine has been of infinite value to our country as it is, but if rendered safe as it might be, its value would be increased fourfold. It is now no longer necessary that the manufacturer should locate beside a waterfall, and transport his manufactured goods for miles to a market; he can establish himself beside the railroad, the steamboat, nay, in the city itself, where his customers dwell. Thus, the stationary engine tends to centralize manufactures, while the locomotive and steamboat lengthen the arms of trade.

The portable engine has lately come into general use, and, like the stationary, is made of various forms, in all of which it resembles the latter, with the exception of placing the engine directly upon, or against the boiler. These engines are used wherever it is necessary to do work sufficiently great to pay for them, but not for permanent business, such as pile driving, excavating, etc. Among the simplest of this class of engines, may be mentioned Reed's oscillator, and the Wood & Mann steam-engine Co.'s. A portable engine manufactured at the Washington Iron Works, contains all the safety and economic appliances of the best stationary engines; a description of this will answer for this class of machines. The boiler is tubular, commonly called a locomotive boiler, and is mounted upon two large wheels at the fire-box end, and two small wheels at the smoke-box end, so fitted as to turn beneath the barrel. The steam dome is over the fire-box, and is fitted with safety-valve and steam gauge. The cylinder is fastened to a hollow frame that serves as a feed-water heater, and is placed very near the steam dome, thereby preventing radiation in the steam pipe. Upon the top of the steam chest is placed the governor. On the front of the boiler we find the smoke pipe, and, directly behind it, the main shaft and a pair of balance wheels. The next matter of interest is the arrangement of the main slide-valve of the engine, which is well known to cause much loss of power, in the ordinary construction, by the friction caused by the pressure of steam on its back. This is entirely relieved by a very simple method in this engine. The valve, which is an ordinary one, has a solid protection at each end, which rests on a roller. These rollers are made at first slightly too small, but the grinding away of the valve on its seat soon causes the projections to rest on the rollers, when all the sliding friction at once ceases, and the valve works free from friction except that caused by the stuffing-box around its rod. It is evident that this arrangement will not readily get out of order, for when the rollers wear, it brings the valve on the seat, which at once begins to wear, and the pressure once more is brought on the rollers; hence, it is self-adjusting. The rollers being removed, reduces it to the usual slide-valve.

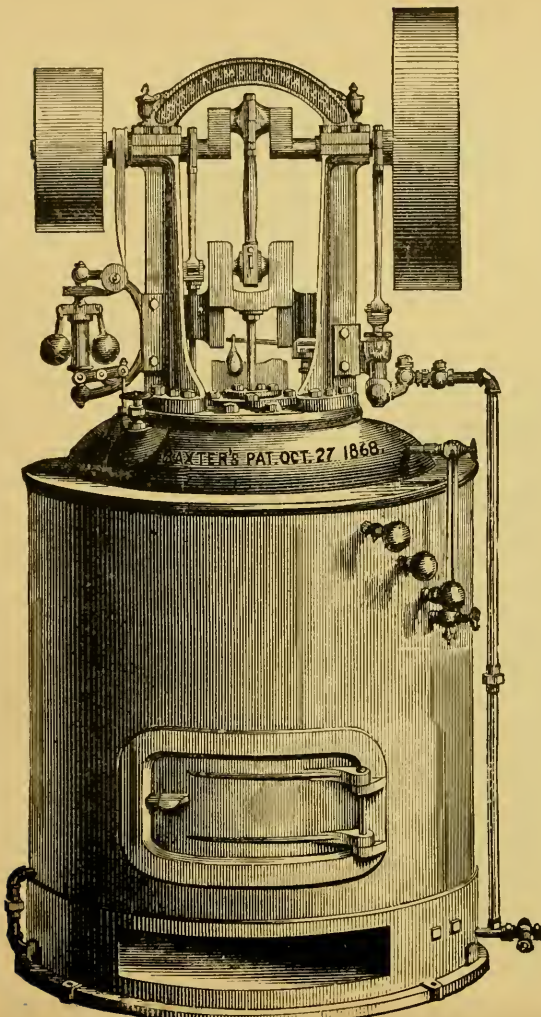
The force pump has been a fruitful source of trouble to all those who have ever had charge of a small steam engine having a quick motion; indeed, it frequently gives trouble in larger engines, from the accumulation of air in the chamber, which prevents its suction. It is usual to have attached to the lower part of the pump, or valve chamber, a small air-cock, and, when the pump is to start, the attendant places his finger on its extremity as soon as the plunger reaches the bottom of the pump, thus expelling the air; then, on the rise of the plunger, a vacuum is formed, and the pump fills with water; the cock is then closed, and the pump left to itself. As soon, however, as air collects from any defect of packing, or otherwise, the pump ceases to work, and has to be again started as before. This difficulty is entirely got rid of by the simple contrivance of an air-trap, whose valve, opening outward at each downward stroke of the pump, allows the air to escape, accompanied with a little water, and closes by the atmospheric pressure as the plunger rises.

Within the last five years, the labor of loading and unloading vessels at our wharves has been performed by hoisting engines. These are all run at high pressure, and do the work with economy and dispatch. One of the best of these machines is made at the shop of Hittinger & Cook. Several of the ocean steamers carry them to use at the other end of the route. The hoisting so much resembles the portable engine, as not to require especial explanation.

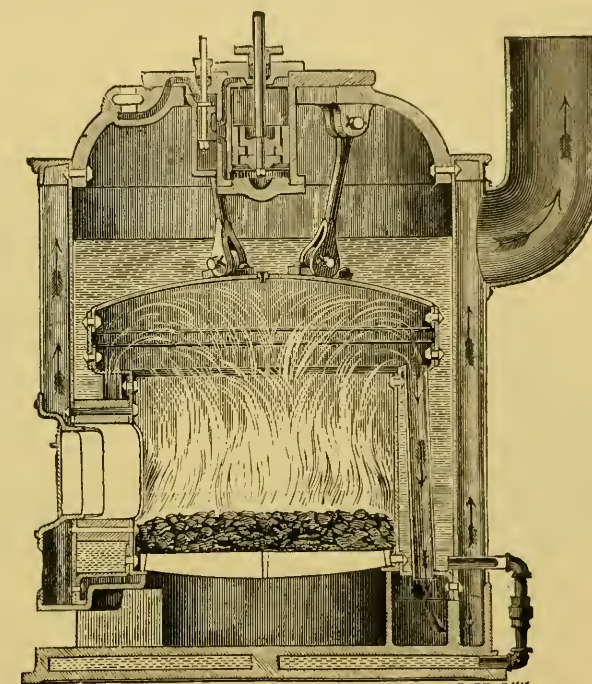
In most of the steam sawmills in the United States, the fuel consists of the sawdust made at the mills, and thus the cost of running is greatly reduced; in other engines, coal is almost exclusively used. In fact, the enormous amount of wood consumed by steam engines throughout the United States, has so called the attention of mechanics to coal-burning engines, that it is not probable we shall use wood as fuel many years longer. One of the greatest fields for economy in the use of steam, now open, is the waste of combustible gases by the chimney, commonly spoken of under the term *smoke*, but often consisting of the best part of the fuel, unconsumed from the lack of oxygen, and, in some cases, lack of caloric. Tubes, to conduct atmospheric air to the surface of the fire, have been in use some time, also the perforation of the fire door; but the tubes being exposed to an intense heat, soon become of no value, and the openings at the door and sides of the fire-box only partially supply the oxygen. A Mr. Pierce, of Troy, has patented a plan for surrounding the air tubes with water, thus protecting a passage direct to the middle of the fire; we have not seen this plan tried, but think it would be a source of economy.

Stationary engines being the most plenty, it is upon them that are tried nearly all the new experiments. At the present time, the use of super-heated steam is attracting a great deal of attention. In order to understand this subject, it is necessary that we should look closely into the nature of steam itself. It would defeat the purpose of this article if we were to go into a lengthy argument upon the relative merits of the various theories that have been advanced by scientific men upon steam, and, consequently, we shall merely give our own opinions upon the subject—opinions at which we have arrived by careful study and experience, it being understood that the laws of steam are at best comparatively unknown. The analyzation of simple steam is yet to be made; we will, however, call it water converted into an aëriform state by the electrization of its particles by caloric. Simple steam does not, however, in the present construction of boilers, come into use as a motor, from the following reason: steam has the same affinity for liquids that all fluids have, forming an electro-magnetic combination to which there is no barrier; it will then absorb and hold in suspension particles of water whenever in direct contact therewith, and, consequently, all steam formed in the boiler will hold in suspension a portion of water, and become, in lieu of simple, surcharged steam. Thus, steam at 20 lbs. to the square inch holds in suspension nearly double its weight of water. What is the effect of this? First, the water thus carried off in suspension is at the maximum temperature, or equal to that of the steam containing it, and the invested heat of this water is not only wasted to a great extent, but these water particles become a very serious tax upon the real steam with which they are admixed, as follows: having been heated under the maximum pressure of the steam with which they are incorporated, they have a corresponding temperature, and as the latter, the steam, expands in the steam pipes, on its way to the cylinder, and in the cylinder itself, the pressure becoming correspondingly less, these particles flash partially into steam, but not containing the total amount of heat necessary to their constitution as elastic vapor, they absorb into the "latent" form a quota of heat from the surrounding particles of true steam, thus condensing them; for steam, be it remembered, can part with no portion of its legitimate heat without condensation (unless it be super-heat, of which presently), it being understood that the absorption of sensible heat (temperature) into the "latent" form, and which is the exact measure of the force exerted by steam under all circum-

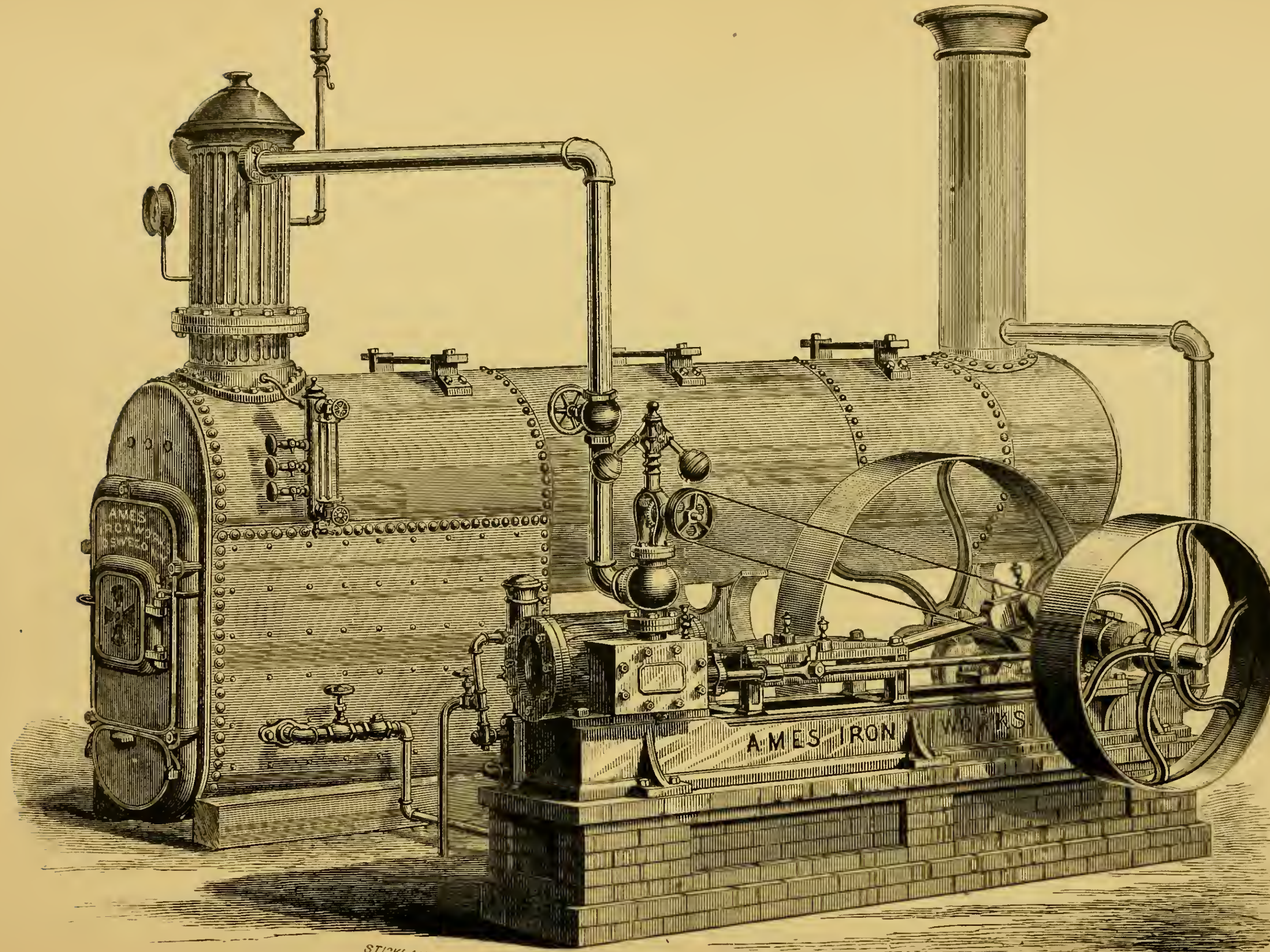
THE BAXTER STEAM-ENGINE,—Front view.—Ready for use.




Sectional View,
Showing the interior of Boiler, Furnace, Cylinder, Valves, Water Bottom, &c.



This style of Boiler is used with the 3, 5, 8 and 10 Horse Power Engines.




PORTABLE STEAM ENGINE. MANUFACTURED BY AMES IRON WORKS, OSWEGO, N. Y.

stances, whether usefully realized or not, is not here meant as a loss of heat. That there is a loss by direct condensation because of the presence and action of these water particles as explained, may seem to some at the first glance a paradox, but there is in the case of steam, and between the particles of all matter, a certain impetus and momentum in the transference of that unknown something, which is their "*vis viva*," or cause of elasticity. The electrician knows this well; *vide* the "lateral discharge" and return stroke. Again, for more common place example, fasten by one extremity a straight spring, bend it, release it, it flies back, not to its original position of rest or neutral point, but far beyond, though finally it will settle there. And so it might be held that the particles of steam would make "reprisal," so to speak, of the heat stolen by the particles of water flashing into steam, as set forth; and so they do, but meantime the piston is moving on, and this heat, the source of the elastic force of the steam, cannot, it will be evident, be acting efficiently in two or more directions at the same time; but this is not all, the more watery particles in the steam, the more heat wasted by conduction to, and radiation from, the steam pipes, cylinders, etc.

Water is classed as a non-conductor of heat to a high degree, but it is a medium radiator, and it vastly exceeds steam and other aëriform fluids in both these respects. This, to a great extent, accounts for the sudden falling off of power during "priming," so well known. But there is still another, as it were, negative loss due to this water carried off in the steam, because, by its minute subdivision, it exposes an immense surface to heat, particularly radiated heat, that might be brought to act upon it, and thus quickly transform it into perfect steam, much augmenting the volume of the whole, and being generated at less cost than the first portion which held it in suspension; and it is through the avoidance of the evils before mentioned as due to these water particles, and the gain produced by their conversion into elastic steam, that so much economy is found in the use of super-heated steam, which is steam that has received an excess of heat (temperature) beyond that normally due to its pressure when in direct contact with the water from whence it emanated. The system, however, is fallacious, because pure steam, and all other known aëriform fluids, expand only about 1-540th part of their volume, at the ordinary atmospheric temperature, for each degree of Fah. additional forced upon them. Pure steam thus, say at twenty pounds to the square inch, would require to be elevated to a temperature of about eight hundred Fahrenheit to double its volume if under a constant pressure, or to double its pressure if under a constant volume (the quantity of heat being, however, very different in the two cases); whereas the mere added temperature in this case would correspond to that of simple steam at a pressure of about seven hundred and fifty pounds to the square inch, not to mention that such, and far less temperatures, would destroy all packings, prevent lubrication, cause "cutting," warp valves, etc. There are other practical defects. Although there is no difficulty in super-heating the steam to any desired extent according to the size of the super-heating vessel and the part of the smoke or fire space in which it may be located, yet it is very difficult, if not impracticable, to maintain a proper average under the influence of fluctuating fires—at one time in full glow, at another freshly trimmed, and an uneven draft, damp or dry, weak or strong; the engine at one time under full motion, and a rapid flow of steam passing through the super-heater, and at another time the engine stopped, and there being little or no flow of moist steam through it to protect it from being overheated and "burnt out," or rendered brittle and insecure. Hence, if super-heating be attempted at all, it should be to the minimum degree, and not with the expectation of an important access of power that no degree will afford, but only to an extent sufficient to supply radiation from the various parts of the engine, etc., during the travel and action of the steam, thus preventing its condensation, which, to a given extent, involves not only that much immediate loss, but the more important coactive evils due to the presence of watery particles. The great and main object, then, is accomplished by the production and use of simple (dry) steam; any modicum of water present possessing but the negative advantage of supplying lubrication, and any "super" heat, that of supplying radiation.

A few words on the subject of large pumping engines, may be of interest to our readers. Opinions have been much divided as to the comparative success of the Cornish engines, and other models. An opportunity offered in 1859–60 of putting the question to a practical test. The Nassau Water Department of Brooklyn, N. Y., required a pumping engine to raise the water from their conduit into their great distributing reservoir, for the supply of that rapidly growing city. Their board of engineers, thoroughly informed as to what Cornish engines had done elsewhere, stipulated that the engine to be contracted for should be required to lift six hundred thousand pounds of water, one foot with one pound of coal; that it should deliver ten million gallons of water into the reservoir every twenty-four hours, and be capable of doing that amount of work in sixteen hours. Messrs. Woodruff and Beach, (now the Woodruff and Beach Iron Works,) of Hartford, Connecticut, took the contract, and their pumping engine, a double-acting Cornish engine, with some modifications and improvements, stood the test as to duty, (600,000 pounds of water raised one foot by one pound of coal,) and exceeded the test as to capacity, delivering 14,500,000 gallons in twenty-four hours, and when crowded doing nearly as much in sixteen hours. At the time of its erection, it was unquestionably the most powerful pumping engine in the world.

The work required of this engine soon proved too severe for it, and in 1862 a second engine of nearly the same pattern, though with some minor improvements, was built by the same manufacturers, and placed alongside the first. Though testing up to the requirement of the engineers in the matter of duty, neither of these engines, in actual practice, has exceeded 543,488 foot pounds per pound of coal, and the first engine has not, since 1865, exceeded 500,000 foot pounds. For several years the pumping duty of the two engines was comparatively light, as, until 1865, a daily consumption of ten million gallons of water was never reached; but from that time the consumption has rapidly increased, and both engines requiring very frequent repairs, and falling off in the amount of their work, a third engine of greater power than either of the others was ordered, and this time of a somewhat different construction. This engine, built by Messrs. Hubbard and Whitaker of the Burdon Iron Works, Brooklyn, is called a beam rotative engine, with a "Thames Ditton" pump attached, placed directly under the steam cylinder, and worked by a continuation of the main piston rod through the bottom of the cylinder. The fly-wheel for regulating the motion of the engine is twenty-six feet in diameter, with rim twelve inches face by eighteen inches deep. The distribution valves are the double poppet or balance valves; and the point of cut-off, or degree of expansion, is determined by the time of tripping or dropping the steam valves, which point is regulated by the engineer. The bore of the pump cylinder is $50\frac{1}{2}$ inches, and the diameter of the plunger 38 inches—the stroke of both steam piston and pump piston being 9 feet and $11\frac{3}{4}$ inches. The air chamber for the pump is six feet in diameter, and about 35 feet in extreme height, with a semi-globular top or cover, and has a diaphragm division-plate fitted with check-valves to regulate the return flow. There is no feed pump connected with the engine for supplying the boilers, this being done by an independent steam pump. For supplying this engine with steam there are five "drop return-flue boilers," seven feet in diameter, and twenty-four feet in length, well set in brick masonry; so arranged that any number or all of them can be shut off at pleasure.

This engine, undoubtedly the largest and most powerful pumping engine in the world, was set in November, 1869, and tested both for duty and capacity, in December, by Messrs. Worthen and Copeland, eminent and disinterested engineers. Its average results on the "duty" test were 750,000 pounds of water raised one foot with a pound of coal; its capacity, the pumping at the ordinary speed 18,500,000 gallons of water into the reservoir in twenty-four hours, with a proved capacity for pumping 21,000,000 gallons in the same time. The consumption of the Ridgewood water is now (1870) a little short of twenty million gallons per day, at some seasons of the year, so that this engine is capable, upon an emergency, of doing the entire work. The frictional loss between the cylinder and pump, new as the engine was, did not exceed $7\frac{1}{2}$ per cent. Remarkable as this performance is, it will undoubtedly be surpassed within the next ten years.

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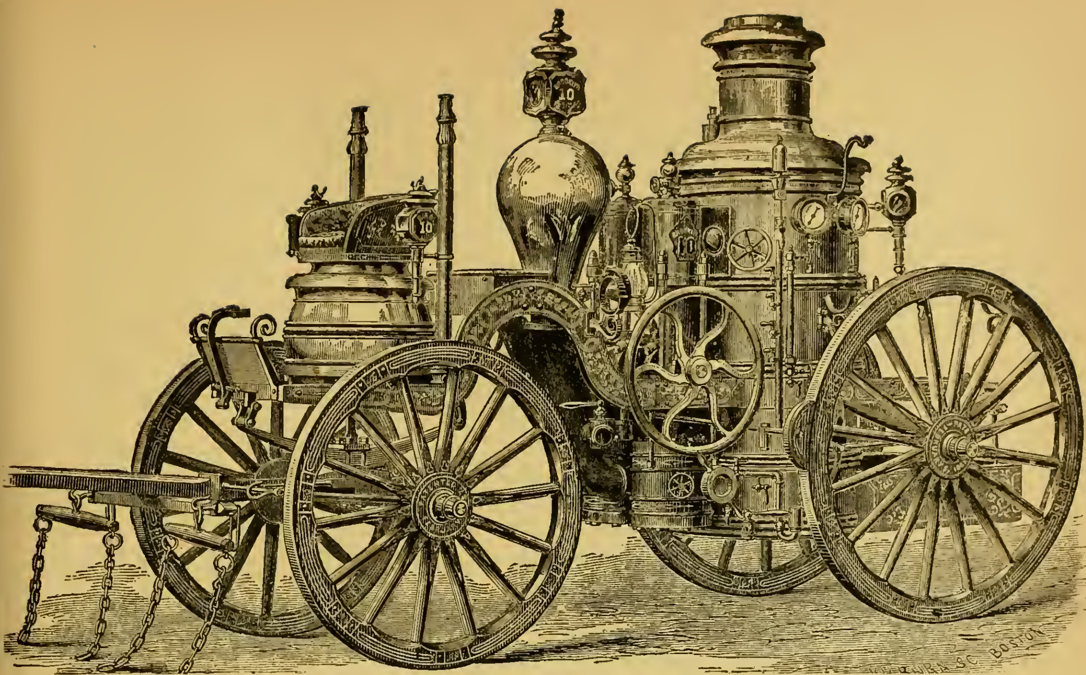
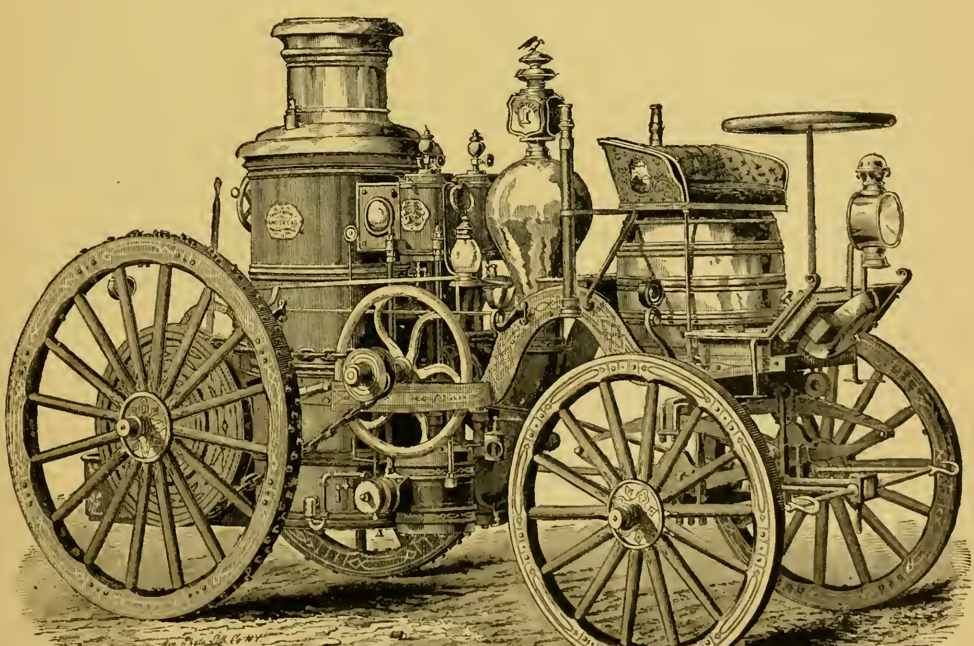
## CHAPTER V.

### STEAM PUMPS.

The great desideratum in a machine for extinguishing fires, is the rapidity with which



"AMOSKEAG" DOUBLE PLUNGER STEAM FIRE ENGINE. CRANE NECK FRAME.



"AMOSKEAG" SELF-PROPELLING STEAM FIRE ENGINE. CRANE NECK FRAME.

it can be set to work, and next to this the quantity of water it will throw to a given height or distance. The machines that best filled these conditions were doubtless the American hand fire engines; but steam has now turned fireman, and in the contest between his iron arms and human muscle, we can readily determine the result. At first, time was the all-important item; all were ready to acknowledge that after the fire had attained full headway, the untiring efforts of steam were all-powerful, but as the majority of our fires were nipped in the bud by the rapidity with which the hand engines were brought to bear, it was not believed that steam would ever become economical, and rarely efficacious. An engine was constructed for the insurance companies of New York some twenty years since, but abandoned as too expensive; it was located in a house containing a boiler, wherein steam was constantly kept up at a low pressure, and so arranged as to discharge its water into the engine on an alarm of fire being given; beneath the boiler of the engine, shavings and light fuel were kept constantly laid, so that by the time the machine reached the fire it would have steam up and be ready for use. This was planned by Ericsson, who also planned the Braithwaites engine, used in England. The latter had two cylinders of about six inches in diameter, one for steam and the other as a pump; they were placed horizontally. This engine would deliver nine thousand gallons of water per hour to the height of ninety feet. The time consumed in getting to work from cold water was eighteen minutes. An engine built for the Prussian government in 1832 had two steam cylinders of twelve inches in diameter, with fourteen inch stroke, and two pumping cylinders of ten inches diameter. With a steam pressure of seventy pounds per square inch, this engine threw an inch and one quarter stream one hundred and twenty feet perpendicular; and an average duty was called ninety tons per hour. She consumed three bushels of coke per hour.

Such were the first steam fire engines. Experiments were frequently tried in the United States, but the whole subject remained in doubt until the year 1852, when the first public trial was made in Cincinnati. A steam generator, or boiler, which had been made for the purpose, was placed in connection with a steam cylinder and the pump of a fire engine belonging to the city, the whole mounted on suitable wheels and frame. A committee of the city council witnessed the experiment. From their report it appears that steam was raised from cold water, the engine started, and water discharged from the nozzle to the distance of one hundred and thirty feet, through three hundred and fifty feet of hose, in four minutes and ten seconds from the time that smoke was seen to issue from the chimney. The demonstration was convincing, and did convince. The city council contracted for a steam engine to be built on the same plan, and this engine, when completed, was placed in service under the charge of a company organized and put under pay by the city. Thus the first paid fire company, to operate with the untiring energy of steam, was brought into existence—the first of the kind in any age or country. Steam, whose resistless power had been so extensively used in the fabrication, development, and transportation of property, was at last compelled to aid in its preservation from fire. Its superiority over muscular power, acknowledged for other purposes so numerous, was to be asserted against conflagration; and a city not a century old, west of the Alleghanies, attracts the applause of intelligent men everywhere, and the pride of western men, as the scene of this achievement.

After this successful experiment and the organization of the paid department, Miles Greenwood was appointed chief engineer, and it is to his energy and perseverance that we owe the success of the steam fire engine. These steamers were constructed by Messrs. A. & B. Latta; the first in service was called the "Uncle Joe Ross." The circulation in the boiler is kept up by pumping, and thus steam is generated in a very short space of time; it is not, however, unattended with danger. After the success of Latta's engines, several manufacturers went into the business. Reaney & Neafy, of Philadelphia; Lee & Larned, of New York; Silsby Manuf'g Co., of Seneca Falls; the Amoskeag Manufacturing Company; the Boston Locomotive Works, and several others. Reaney & Neafy used what is commonly called the locomotive boiler; their engines gave good satisfaction, and at a trial in Boston, in 1858, they received the prize over three competitors. Of the Lee & Larned self-propeller we have already spoken (J. C. Cary and J. G. Storm); they, however, build a light hand engine, and have heretofore furnished all the steamers for New York city. Their boiler is of the upright annular form, Cary's patent, and their pump is rotary, patented by the same man.

The Amoskeag steam fire engine has some peculiar features, among which may be named the vertical cylinders and pumps, by the use of which they avoid to a certain extent the shaking that is so objectionable in some of the other machines; also the arrangement of their gauge cocks so as to cover the whole side of the boiler and show at once the height of the water, which is used in this boiler at a very low point in commencing, thereby enabling them to get up steam very rapidly. At a trial in New York in September, 1860, they obtained a working pressure from water at 90° Fahrenheit in three and one-half minutes. These machines have thrown a one and three-quarter inch stream two hundred and twenty-five feet high. They weigh about six thousand pounds, and are intended to be drawn by horses. The Silsby Man'f'g Co. engines are entirely different from any other in their construction and operation; the engine and pump are both rotary, and are built after Holly's patent; we have already spoken of this engine under the head of Stationaries. The weight of these machines is as follows: to be drawn by men—three thousand eight hundred pounds light; four thousand three hundred pounds with fuel, water, suction hose, etc., all ready for service; this size is warranted to force a one and one-eighth inch stream two hundred and fifty feet, or two, one hundred and eighty feet, with a steam pressure of from forty to sixty pounds. To be drawn by horses—five thousand one hundred pounds light; five thou and eight hundred ready for service; forces a one and one half inch stream two hundred and for y feet, or two one inch streams the same distance. These machines will get to work in from four to six minutes. An engine of this style in Providence, R. I. (where they have seven in service), weighing five thousand and eight hundred pounds, threw a one and a quarter inch stream two hundred and fifty-five feet horizontal. One great advantage of the Holly pump is that it runs steadily, no chocking being required to keep the engine in place while on duty, as is the case with all engines having reciprocating pumps.

Other steam fire engines, for the use of factories and large buildings, not intended to be transported, have been in existence for a greater length of time; these machines are also used as auxiliary pumps for supplying water to the boilers of larger engines, and are generally called "doctors," or "donkeys." Among the best of these are Worthington's and Woodward's steam pumps. The importance of an auxiliary pump, in all cases, cannot be too much dwelt upon. If the pump be attached to the main engine, it is evident that on the lack of water in the boiler, the main engine must be started. This is not always possible. A sudden break down in a mill would necessitate the uncoupling of the shafting before the boiler could be fed. The lack of water at a station when waiting for a train, obliges the engineer to run back and forth upon the road; and if a boat stops at a wharf, or is enveloped in a fog, the power that works the pump ceases with the engine. But how is it when the engine itself breaks down, or the locomotive is embedded in a snow bank, as is sometimes the case? Why, the engineer must draw his fires to avoid ruining his boiler. Bearing these facts in mind, the advantages of an extra steam pump are obvious.

The Worthington pump is exceedingly simple in its construction; as the reciprocating motion in the steam and water cylinder is the exact motion required, the cross-head, slides, and balance wheel are dispensed with as useless. In the Woodward, however, the connecting-rod, crank, and wheel are retained to give motion to the valve, which in Worthington's pump is moved by an arm attached to the piston rod. Both of these pumps are favorites, and it is difficult to judge which is best. The importance of these steam pumps as auxiliaries is not, however, their only advantage. On board of our steamboats, such pumps as are provided in case of fire are often rendered of no avail by the necessity that exists of stopping the progress of the boat in order to check the current of air, which otherwise would increase the flames. And let a fire engine be kept on board for the single purpose of extinguishing fires if they happen—does not our common experience teach us that in so imminent a danger, when all are seeking personal safety, and unwilling to await the issue of a doubtful effort for the general preservation, such a machine will be found a very questionable dependence? Will they not be difficult of access at the moment, or out of order, from rust or disuse, when most needed? And does the confusion, which is always attendant upon such an occasion, allow of reasonable hope that they will be found and repaired in time to be of use?

These are questions which can, perhaps, be best answered by those who have witnessed the scene of a steamboat on fire. But with the "donkey" engine, the case is quite different; being constantly in use, it is always in order, and in case of fire it can at once be brought to bear upon the flames; it is also always at hand in case of a leak that overpowers all other available pumps; and, in fact, its advantages are so great that no boat, locomotive, or stationary engine should ever be run without one. For large pumping operations, also, it is believed that the Worthington pump has many advantages. The power is direct, all the motions are rectilinear, the friction is not great, nor is the wear excessive. A steam and a pump cylinder attached to one frame, with two pistons, two valves, and two rods, comprise the whole machine. The economy of the donkey engines is obvious where steam is only employed for boiling, or for warming buildings, and where the large and costly engines usually provided in such cases, are used solely for driving a pump to supply the boiler. The steam used to drive it, whether of high or low pressure, is, of course, just adequate to the required work of forcing water into the boiler against the same pressure.

The Worthington pumps are made of a great variety of sizes, from the miniature ones used as feeders on the Lee & Larned fire engines, up to the huge pumping engines for water works. The only fault we have ever heard found with them is the trouble of starting; this cannot, however, be very great, inasmuch as a pump, to be efficacious as a feeder for a fire engine, must be readily started or it would be almost valueless. The Woodward pump has much more brass used in its construction than any other, and is therefore not so liable to rust. The Holly pump has been constructed as an auxiliary engine, and, in fact, on some of their larger machines a small one is used as a feeder; it occupies but very little space, and is well spoken of by those who have used it. A pumping engine manufactured by Messrs. Carpenter & Plass, of New York, patented in 1859, and has the advantage over the Worthington of starting at once on opening the throttle; it being fully as simple. Other pumps of this class are manufactured all over the country, but none are so well known as the ones we have named. On some of the western steamboats they use small engines of the ordinary construction attached to the common force pump, but in no case are they so compact, easy of repair or durable as the above-named steam pumps.

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## CHAPTER VI.

### MISCELLANEOUS.

In the former chapters we have set forth the various forms in which the adaptation of steam is most familiar to the community; in all of which steam was used as a motor only; and before dismissing this portion of the labor of steam, we will allude briefly to some other machines, destined, perhaps, to effect as great a revolution in other branches of industry, as the locomotive and steamboat have in transportation, and the stationary in manufactures. Agriculture—that wide extended base, upon which we have built up this great fabric of commerce, manufacture, and trade—has been the last to experience a direct benefit from steam. The farmer is pre-eminently conservative, to which the monotonous routine of his business predisposes him; but the course of the giant worker, steam, is irresistible, and he, too, at last accepts its aid. For some time past the portable engine has been introduced to assist the farmer in the laborious duties of his calling, and soon will the iron horse be chained to the plough, swing the gleaming scythe, sow, reap, thresh, and winnow, while the husbandman will guide and direct the iron arms which do his bidding uncomplainingly. Already has the shriek of our new friend been heard upon the western prairie field, and the smooth-turned furrow attested his strength, but as yet he takes not kindly to his new-found toil, and the brains of a score of inventors are at work to teach him this new duty. "God speed the (steam) plough," say we.

But this great problem, the education of steam to its new duty, presents many difficulties. There are three kinds of engines—the locomotive, the portable, and the stationary—capable of being employed in steam cultivation; and there may, consequently, be three kinds of steam cultivators invented, each characterized, in its general features, by the kind of engine employed; though under each class there may be many modifications of parts, rendering the members of the same class as widely different as those of different classes. These varieties would be determined by the structure, form, or size of the engine itself; by the mode of conveying the power to the tools or implements with which it works; and by the nature of the tools or implements it uses. First, then, the locomotive steam plough; this may be employed to draw a gang of ploughs after it, or by a series of knives, cutters, or some form of cultivator, turn up the ground as it passes. The moving of this great mass, however, consumes much of the power, and the difficulty presented by steep grades is very great. The mere sinking of the wheels may be obviated, as it is in the Fawkes engine, by broad wheels, but even these sometimes slip. In Boydell's engines the machine lays and takes up alternately a succession of rails, upon which to roll. Hacket proposed to lay a temporary rail, but found it very expensive. The use of legs, or pushers, has also been tried in England, but was not successful.

The portable engine has been used in several ways. As a cultivator it was mounted upon a wagon drawn by horses. As a plough it has been placed by the side of the field, working a gang of ploughs by chains and cables; and after finishing one field, easily transported to another; this was called in England the Wolston system, but is at best very slow. The portable engine has also been used with anchors, and to warp, or draw itself along by stretched ropes. Each of the above methods of employing steam has its peculiar difficulties and defects. In the first one, two horses would be required to draw an engine of the lightest construction over safe ground, and up and down hill; and the advantage of the machine over animal power alone, would be only the difference between its work and what the team would do without it. The inventor, however, calculates that with an engine of two horse power, and of suitable construction, working a revolving axle, carrying tires armed with a kind of short spade toward their points, he can do the work of twelve horses, giving the work of ten horses and their attendants for the cost of feed and repairs, pay of attendants, interest of capital, etc. In the Wolston method the mode of transferring the power is indirect, the apparatus is complex and clumsy, and its success, thus far, has been but small. In the third plan, or that of the warping engine, the inventor asserts that he requires an engine of less than one-half the weight, power, or cost of any locomotive; that he avoids all indirect strain upon his cable, by getting the engine to warp itself from one side of the field to the other, by means of a single rope passing a couple of times round a drum; that the anchor at either side can be removed and passed forward six or eight feet, by one man, while the engine is travelling across the field; that, when using rotary cultivators, he has but little strain upon his cable; and, lastly, that when he is drawing ploughs, etc., he has the whole traction power of his cable to prevent his being brought to a stand by his wheels slipping. The stationary engine has been used to some extent, but we do not think it has sufficient merit ever to come into practical use.

As a motor for a dredging machine for deepening our rivers and harbors, steam has been in use since the time of Oliver Evans; and as an excavator it has long ago distanced human opposition. The millions of dollars that are annually expended in excavating earth, have attracted the attention of inventors to devise modes of aiding the operation by machinery, and large and costly machines have been made for this purpose in certain situations, especially in deep cuts of soft sand, which work well, and perform the labor of many men. Among many others, Messrs. Goodale & Marsh patented last year a machine that not only acts as an excavator, but transports the earth to the desired place of deposit, it being intended to work in ground free from large stones, or nearly so, and where the hills are not too steep for the ascent and descent of a locomotive running on broad wheels on the ground. This machine will prove particularly useful in the west.

Steam has always benefited the farmer by bringing him nearer to a market, and inasmuch as it reduces the expense thereof, it necessarily adds to his profit. The handling of the large amount of grain that annually passes through the large warehouses of our western cities, is of itself no small item, and here, too, steam lends its assistance, being adapted to the large steam elevators of Chicago. It has benefited the blacksmith indirectly by blowing his furnaces and driving the trip hammers, and directly within the past ten years in the immense steam hammers, where it is so much under control as to give a blow of several tons weight, or crack a walnut in the attendant's fingers without harming him. For this advantage we were at first indebted to England; but we are improving upon the model, and steam hammers will soon come into general use, of American manufacture alone. An enormous steam hammer on Naylor's principle was sent, in 1860, to Australia. The hammer is not only lifted by the pressure of steam from below, but the gravity of the falling hammer is assisted by the pressure of steam from above. The work is finished at one heat, saving both the fuel and time of second heats, also consequent deterioration and waste of iron. The effect of the blow of this hammer will be equal to the momentum acquired by sixteen tons making forty blows per minute. The hammer can be made to work double or single, acting instantaneously; and by the adjusting valve gearing, the length of stroke and force of blow can be changed instantly. In all gravity hammers the effect of the blow is dependent on the weight of the hammer, multiplied by the height of its fall, and consequently, the greater the distance it falls, the greater the force of the blow, and the slower is the speed of working. In the double-action hammer, thrice the force of blow can be given at double the speed. The principal dimensions and weights are: timber foundation, twenty-six feet by twenty-four feet six inches, depth, thirteen feet; cast iron anvil block, base eleven feet six inches by nine feet six inches, thirty tons weight; base plate to receive standards, nineteen feet six inches by fifteen feet six inches, fourteen tons weight; standards, ten feet six inches apart, weight fifteen tons; height from ground to top of steam cylinder, twenty-one feet six inches; weight of all, about seventy-five tons. Steam to work this hammer is generated from the furnace in which the work to be operated upon is heated, the boiler forming the chimney, and the heat passing up four flues in the same, thus economizing fuel and avoiding the expense of a brick chimney. The boiler is six feet six inches in diameter, and thirty feet long; weight, fifteen tons. The weight of the whole apparatus, including boiler and mountings, is about one hundred tons. This apparatus was constructed in England.

Steam has also been applied to cranes with great success. One of Morrison's steam cranes was recently loaded with forty-five cwt., the steam cut off from the boiler, and the load left to hang from the crane by the power of the steam already in the crane cylinder. After hanging for half an hour, the weight had descended only four inches. Many other applications of steam as a motor might be enumerated if space would allow, but we must now turn to the multifarious duties of steam in the useful arts. One of the most important of its applications is its use as a vehicle for transferring and uniformly distributing heat. Its large capacity for caloric gives it great efficiency for this purpose, as it holds and will communicate as much heat as a mass of red-hot iron, and will transmit this heat to a great distance, which iron will not do, for the heat will remain latent until the steam reaches its destination and becomes condensed. In order to apply steam to the warming of buildings, it is only necessary to use a close boiler, from the top of which a steam pipe can be carried to the top of the building; the boiler being placed as low as possible. This steam pipe is at the top connected with a series of larger ones, placed with a slight inclination near the floor of each room, connected each with the one above it, at its highest end; thus giving facility to the descent of the condensed water, which is so directed as to re-enter the boiler near the bottom. By such an arrangement, properly constructed, the entire caloric produced by the furnace will be distributed over the building. The small, or steam pipe should be made quite strong, and should have at least an area of one square inch for every six gallons of water evaporated per hour in the boiler. It will require occasionally an addition of water to supply accidental waste, and a ball-cock connected to the feed pipe would be useful; but by all means have a safety-valve upon the boiler.

The extent to which buildings are now heated by steam in this country is very great, and since the introduction of Gold's apparatus, Brown's, Baker, Smith & Co.'s, and other steam heaters have been added with great advantage to private dwellings. They are certainly much more healthy than hot air, and, properly arranged and managed, need not be more expensive. The pressure is merely nominal, and therefore not a source of danger; the only disadvantage, that of leakage, is no greater than in the use of gas pipes. For large factories, steam as a heater is invaluable; and for warming hothouses, nothing can supply its place. It gives an equal heat, and is devoid of that dryness so injurious to plants. To warm a greenhouse by steam, there is required the boiler of a steam engine, reckoned at one horse power for every thousand feet of glass. It is advisable, when heating a hothouse by steam, to surround the pipes with stones; these stones absorb the heat, and if from carelessness or inattention the steam goes down, they will continue to radiate heat for some time, thus preventing the sudden cooling of the place.

It is sometimes necessary to boil liquids in vessels of wood, as in brewing, etc., and to use heat in evaporating thickened liquids, strong solutions, etc., where the direct application of fire would be destructive; there, also, we see the utility of steam. The common manner of making glue is an instance of this; elevate the bottom of the glue-pot and cover the receptacle for boiling water, and you have at once a steam oven. This plan has been extensively used in making salt. Or, introduce a pipe in the form of the worm of a still into the vat containing the solution, and allow the steam to pass through the pipe. The steam pipe can then be of iron, copper, lead, or tin, as the nature of the solution may require; copper is in all cases the best where it can be used. Another process of a similar nature was invented by Mr. Goodlet, of Leith; it consists of pumping the solution through a spiral pipe passing through the boiler, thus bringing the solution to the steam, instead of the steam to the solution. Steam kilns for drying grain have also been used upon the same principle. Dry houses, for lumber to be used in the pattern room, are added to our machine shops. The process of drying printed cloths and fabrics of various kinds, also the warp after it is sized, is in use in all our principal manufactories, and adds materially to the economy and expedition of their production. The process of drying clothes illustrates this. Steam is conducted through the axis of a cylinder, which is revolved by suitable machinery; the cloth is then made to pass over it in contact with its periphery; if necessary, several cylinders are placed in a line, and the cloth passes over the first, under the second, and so on. Paper is thus dried: the wet pulp laid out on the web of wire cloth is gradually strained as it approaches the cylinders, around which it winds, until it comes off dry and ready for cutting; this operation is singularly interesting.

Cooking by steam was the invention of Denis Papin, of France, as long ago as 1680; the most important of whose experiments were the extraction of gelatine from bones, and the manufacture of essence of meat, soups, etc., suitable for long sea voyages. From a work published by him in 1681, we extract the following: "I took," says he, "beef bones that had never been boiled, but kept dry a long time, and of the hardest part of the leg; these being put into a little glass pot with water, I included in the engine, together with another little glass pot full with bones and water too, but in this the bones were ribs, and had been boiled already. Having pressed the fire till the drop of water would dry away in three seconds, and had ten pressures, I took off the fire, and the vessels being cooled, I found very good jelly in both my pots; but that which had been made out of ribs had a kind of a reddish color, which I believe might proceed from the medullary part; the other jelly was without color, like hartshorn jelly; and I may say, that having seasoned it with sugar and juice of lemon, I did eat it with as much pleasure, and found it as stomachical, as if it had been jelly of hartshorn." Mutton bones are better than beef bones; and he infers, first, that one pound of beef bones affords about two pounds of jelly; second, that it is the cement (gelatine) that unites the parts of the bones, which is dissolved in the water to make it a jelly, since after that, the bones remain brittle; third, that few glutinous parts are sufficient to congeal much water, "for I found that when the jelly was dried, I had very little glue (gluten?) remaining; fourth, I used it to glue a broken glass, which did since that time hold very well, and even be washed as well as if it had never been broken; fifth, it is heavier than water, and sinks to the bottom; sixth, hartshorn produces five times its weight of jelly.

"From all these experiments, I think it very likely that if people would be persuaded to lay by bones, gristles, tendons, feet, and other parts of animals that are solid enough to be kept without salt, whereof people throw away more than would be necessary to supply all the ships that England has at sea, the ships might always be furnished with better and cheaper victuals than they use to have. And I may say that such victuals would take up less room, too, because they have a great deal more nourishment in them in proportion to their weight. They would also be more wholesome than salt meat. Vegetables, such as dried peas, may also be cooked by the steam of salt water without becoming salt."

We have already mentioned that Denis Papin invented the safety-valve; it was in the construction of this digester that he used it; he thus speaks of it: "To know the quantity of the inward pressure, you must have a little pipe open at both ends, this being soldered to a hole in the cover, is to be stopped at the top with a little valve, exactly ground to it. This must be kept down with an iron rod, one end of which must be put into an iron staple, fastened to the bar, and the other end kept down by a weight, to be hung upon it nearer or further from the valve, according as you would keep it less or more strong, after the manner of an ordinary Roman balance or steelyard."

Papin's method of determining the temperature is somewhat curious: "To know the degree of heat, I hang a weight to a thread about three feet long, and I let fall a drop of water into a little cavity made for that purpose at the top of it, and I tell how many times the hanging weight will move to and fro before the drop of water is quite evaporated!" As nearly all that we at present know about cooking, and extracting jellies by steam, is derived from the experiments of Denis Papin, we will close this portion of the subject by adding his description of one of them: "Having filled my pot with a piece of a breast of mutton, and weighed five ounces of coals, I lighted my fire, and by blowing gave such a heat that a drop of water would evaporate in four seconds, the inward pressure being about ten times stronger than the atmosphere. I let the fire go out of itself, and the mutton was very well done, *the bones soft*, and the juice a strong jelly. So that, having had occasion to boil mutton several times since, I have always observed the same rule, and never have missed to have it in the same condition, which I take to be the best of all.

"Beef required seven ounces of coal and the same heat, and the beef was very well boiled, although there were more parts of the bones not quite softened. Lamb, rabbits, and pigeons, mackerel, pike, and eel, were subjected to the same process; whence I infer that the bones of young beasts require almost as much fire as those of old ones to be boiled; that rabbit bones are harder than those of mutton; that tough old rabbits may be made as good as tender young ones by this means; that pigeons may be best boiled with a heat that evaporates a drop of water in five seconds; that mackerel was cooked with gooseberries, in a digester, the fish being good and firm, and the bones so soft as not to be felt in eating. I particularly recommend as an excellent dish cooked in this manner, cod fish and green peas."

Another application of steam that has proved very valuable on ship-board, is its condensation after having been evaporated from salt water, to supply the wants of passengers and crews when from accident or an unusually long voyage the regular stores are exhausted. The reader is probably aware that when salt water is evaporated, the steam therefrom is as pure as if taken from fresh, and would be as healthful and palatable as any other were it not from the fact that it does not contain the usual quantity of atmospheric air which has been expelled by heat. If, however, it is allowed to fall in the form of rain, or is poured from one vessel to another, it very soon absorbs a sufficient quantity and becomes as good as rain water, which, in fact, it is.

The application of steam to soften wood, so as to admit of its being bent into various shapes, is old; but by compressing the wood while being bent, so as to prevent the loosening of its fibre, great improvement has been made, and in the manufacture of furniture this has been of great service. There is also a Ship Timber Bending Company in Brooklyn, L. I., who are doing a large business in that line; the timber thus bent being quite as good as if of natural growth.

Steam bakeries, as they are called, show no new application thereof, as they simply consist of dough-raising and other machines driven by a stationary engine; we mention them simply to show how extensive are the uses of steam.

Steam has been used within a few years past in the preparation of paper pulp or fibre from the cane or brake of North Carolina. The canes, softened by exposure to steam for some hours, were discharged from the steam cylinder with great force (by means of the steam) against a granite wall, and were thoroughly disintegrated and formed a pulpy and fibrous mass.

# IMPROVEMENTS IN STEAM PRODUCTION AND USE.

Although it would be assumptive for mechanics to pretend during the last fifteen years, to any radical change for the better, in the means of producing steam as an operating power, it is undeniable that the difference between the burning of fuel and its resultant products of evaporating water to produce operating steam has been largely in favor of the resultant product. Many of the devices for producing steam cheaply have proved their efficiency, so that now a pound of coal can give out twice as much productive — motive — power as ten or twelve years ago; and some boilers, with their comparison and proportion of heating and steam-giving surfaces are almost as far ahead of the old-time methods as the easy-acting pump is ahead of the slow moving and laborious well sweep. It is beyond denial, because well demonstrated, that the boilers set for stationary engines during the last ten years, if not more, do much better service for the amount of fuel consumed than the best which were used previous to that time.

The principal objection to all our coal burning furnaces under boilers was that they allowed a large portion of the products of combustion to escape without yielding their proper proportion of heat; that not only all the visible smoke escaped—that was only unconsumed carbon—but that the invisible gases that ought to be made into radiant flame went with them. This *was* true—this *is* true to too great an extent. It is certain that we derive but a small percentage of the heat force stored in the concentrated carbon of coal for use in our motive apparatus. Statistics are unnecessary in this statement, as we do not care to make this a technical article. But it will suffice to say that under proper mechanical and chemical conditions, the active power from the latent force of coal under combustion may readily be doubled; and it is not too much to affirm that improvements in combustion, in handling of the fuel, in storing of its energy, and in use of its heat, may give a trebled and even quadrupled result.

All of this suppositious result cannot be predicated of improvements in apparatus for combustion and means for storing and giving out the products; much must, necessarily, be left to the judicious attention of those who have this mechanical process in charge. It is as much a necessity to have a good fireman for a steam boiler as it is to have a good maker of the boiler. With the most scientifically constructed steam boiler and furnace, an incompetent firer can make all the improvements of construction of no valuable account.

The feeding of a fire with coal is an art acquired only by practice, or understood by a knowledge of the nature of the fuel and of the proper theory of its combustion. Heavy firing under steam boilers induces the escape of the volatile products of combustion before they have done their work of resolving themselves into heat. For this reason there have been many recent attempts to control the feed of fuel almost automatically, so that only a certain amount of combustible material—fuel—shall be placed on the furnace grate at one time. The recent improvements in grate bars are worthy more attention than has heretofore been given them. One plan has been attended with good results, and that is to allow only a certain amount of fuel to be placed on the fire at one time, gauged by the level of the bed. This is kept at its normal and proper level by means of grate bars that shake down all the debris of combustion as fast as it forms, and in the best types of these contrivances the grate bars are made in short sections that are readily moved by means of a simple shaking lever. The object of these sectional and shaking grate bars is not merely to allow the deposition of the ashes by shaking them down into the ash pit, nor merely to break up gathering clinkers of scoria. Indeed, these are secondary intentions. The primary desire is to so surface the fuel that it shall burn evenly, and instead of offering special facilities for the removal of clinkers, it is desirable that none shall be formed.

Judicious firing with these oscillating bars allows the atmospheric air to pass readily from the under side of the grate through the burning fuel, and aids equable combustion. It is quite certain that when combustion is good, the residuum is reduced to a minimum proportion. Of course it is not possible to predicate entire combustion of any coal, as there is no crude material known that varies to a larger extent in value than coal does as a fuel. But with a good draft, (which simply means "sufficient oxygen") there is no reason why the most ordinary coal cannot be consumed down to its mineral residuum—the ashes.

In fact, the well-known Jarvis setting of boilers, that is specially adapted to the burning of refuse coal and other materials, and which compels unpromising fuels to minister as heat-producers to the steam engine, is simply a sensible and ingenious method of supplying a sufficient quantity of oxygen to the fuel while burning, to insure its thorough combustion.

Mr. Jarvis's plan, however, is not that merely of furnishing a sufficient amount of atmospheric air; he heats the air before using it. The supporting brick walls of the boiler are hollow, with external openings to allow the outer air to enter, and the air is heated by its passage between the interior and exterior brick walls that form the sides of the furnace and ash pit, and the setting of the boiler. This heated air escapes into the furnace at a point near its thither end, just in front of the first bridge wall. The result is not only to burn the volatile escaping products of the furnace, but also to induce a strong natural draft by means of the heated air that is drawn in from the sides, and the cost of fuel is thereby considerably reduced, as it is possible to obtain excellent results with coal culm and dust, spent tan bark, the leavings of dye stuff extracters, saw dust, and green peat.

There is still another claim made for improving the combustion of coal. And that is the use of a hollow grate bar that, being double and open at its front end, takes in the outside air and keeps it until it is allowed to escape at lateral openings at the rear end, or near the rear end, having been intensely heated during its passage from the front to the rear end of the bars.

There are other adaptations of the principle of furnishing a sufficient amount of oxygen to insure entire combustion; but it may be reasonably questioned whether the best do more than approximate to a theoretical result. And entire combustion of fuel with mechanical use of all the heat products is probably too much to expect. It seems as though a portion of the products of combustion *must* be allowed to pass off without mechanical service, as they are necessary in their heated form to rarefy the atmosphere in the smoke passages sufficient to induce an up-lift in the flues and chimney.

The improvements in boilers and other steam generators made during the last decade, or perhaps fifteen years, have been marked. It is noticeable, however, that new types of boilers have been contrived and constructed rather to allay popular fears regarding steam boiler explosions than to economize the consumption of fuel and furnish proper steam for power. Sectional boilers, as globes and tubes, have been recommended, not so much for their steam-furnishing properties as because of the claim that if they exploded, the explosion would be only partial, and therefore be diminished as to danger. It would seem that the sensible idea to be developed would be the improvement in a generator for active steam; surely mechanical skill and manufacturing integrity can insure good workmanship from good materials, and intelligent attention can prevent accident from carelessness. With good boilers, made of good materials and having good workmanship, sensible, judicious care and management can make a boiler explosion almost impossible. We are using steam of much higher pressure than ever before, and yet, although the number of steam boilers in use has enormously increased, the proportionate number of explosions is much less than it was ten or fifteen years ago. Perhaps it could be shown by statistics that the *actual* number of explosions is less than ten or fifteen years ago. It is certain that much greater care is used in the manufacture of boiler iron and steel than formerly; that the workmanship is more exact and faithful, and that more discrimination is exercised in the selection of those having boilers in charge than was the case twenty years ago.

But the boiler has undergone other changes. Much attention has been paid to the internal bracing of boilers, the shell, or cylindrical portion, being thoroughly held to the ends by diagonal braces. It is a lesson to steam users to notice the extra care that is now given to the internal bracing of boilers. A boiler destined to hold water and steam at a uniform pressure of eighty pounds to the square inch is allowed to be tested to twice that amount, and if lacking at this test is condemned or reinforced. Sectional boilers are built of small pipes or large flues, with the idea of utilizing a larger amount of the heat than where the water is held in a body in one envelope, although traversed by heat tubes, forming part of the system from furnace to chimney. This plan is a reversion of the ordinary tube, or locomotive system, in which the products of combustion pass through tubes that traverse the boiler under the water level. In these tube boilers the tubes themselves—usually quite large—are holders of water, and are grouped so that the flames can pass around them. They are united at either end to transverse tubes and so form a nest of boilers. Usually these tubes are inclined in position, the rear ends being lower than the furnace ends, to assist in circulation of the water by gravitation. Some of these boilers give remarkably excellent results in evaporation, particularly when new and clean. A good type is the well-known Babcock & Wilcox boiler.

There have been other recent attempts to improve the usable product of steam. They have been modifications of the pipe system in which only a limited and intermittent amount of water was allowed to be exposed to the heat at one time. The claim made for these systems is that the increments of heat are not partially absorbed and rendered nugatory by acting on an inert body of water, but are made to perform instant work. There is much sense in this idea, and probably the chief objection to its adoption generally, would be the mechanical hindrances which might interfere with a stated and regular supply of water adapted to the amount of steam needed under all conditions of speed. Some very excellent results have, however, been obtained through some of these devices.

The use of steam at a very high pressure has been lately tested with remarkable results. There seems, however, to be a mechanical limit to the use of high steam, owing to its deleterious effect on the mechanism of the engine. Compounding the engines is the partial remedy for the use of high steam—the re-using of the steam from the high pressure cylinder in one or even two other and increasingly larger cylinders, making it do double duty at different temperatures. It will probably be found, however, that there is a mechanical limit to this use of steam. There certainly is an economic limit, for the costliness of the compound engine is as much a bar to its general adoption as to that of the condensing engine.

There have been devices contrived within the last ten years for relieving the ordinary high pressure engine from the load, or obstruction, of the atmospheric pressure of 14.7 lbs. to the square inch in the emission of the steam after having performed duty. This has been attempted by attaching a separate and partially independent condenser that reduces the exhaust steam to hot water, and uses this water for the boiler feed. One of the neatest and most efficient appliances of this class noticed by the writer is that of R. W. Hamilton, M. E., of New York. It is a pump and jet condenser combined, that is, governed in its action entirely by the requirements of the engine and its load. This device has been tested to prove its advantages in increasing the service of the high speed engine from 20 to 30 per cent. with a saving of fuel at the same time.

High speed for engines may be reckoned as one of the advances made in the use of steam during the last ten or fifteen years. Formerly 300 feet piston speed per minute was considered good speed. Some of our recent types of engines reach 700 and even 800 feet per minute. The principal obstacle in the way of the adoption of this system generally, and even its increase of speed, is the difficulty of perfectly balancing the parts and having a corresponding balance on the driven work. There are advantages in this method of using steam rapidly so palpable as to demand attention. The element of time is one of great importance in the use of such a material as steam. Our locomotives use their steam at high rates of speed and there is consequently a comparatively small loss in the inertia of the steam by condensation from radiation. The longer steam is exposed to action in a cylinder the less its power at the end of the stroke. The slower the steam traverses the greater the condensation. Live steam admitted to the end of a four feet cylinder and pushing the piston at the rate of 200 feet per minute, loses its energetic force before it has run its length. But the same amount of steam traversing only eighteen inches preserves a large amount of its initial force at the end of its stroke. For this reason our modern engines are built more nearly "square" than formerly; we give a twelve inch cylinder only eighteen inches stroke instead of forty-eight as formerly.

Summing up the improvements made in steam as a power during the last fifteen years, it may be said that they have been based on two elements—using the steam quickly and improving the workmanship of the engines and the boilers. Instead of being content with the vapor of water, which, like that of the tea kettle, is only a trifle above the energy of the atmosphere, we have insisted on a pure steam with a vastly higher temperature and correspondingly higher pressure. We run safely at 100 to 125 pounds to the square inch where once 40 or 60 was deemed sufficient. We use our steam on the instant. Short cylinders and quick stroke is the rule. The build and material of the boilers are both improved, as must necessarily be the case, and the finish and perfection of our engines are shown more in the proportions of their parts, their adaptions to their purposes, and their exquisite balance in rapid motion than in meretricious ornamentation and fine polish.

### HIGH PRESSURE AND LOW PRESSURE ENGINES.

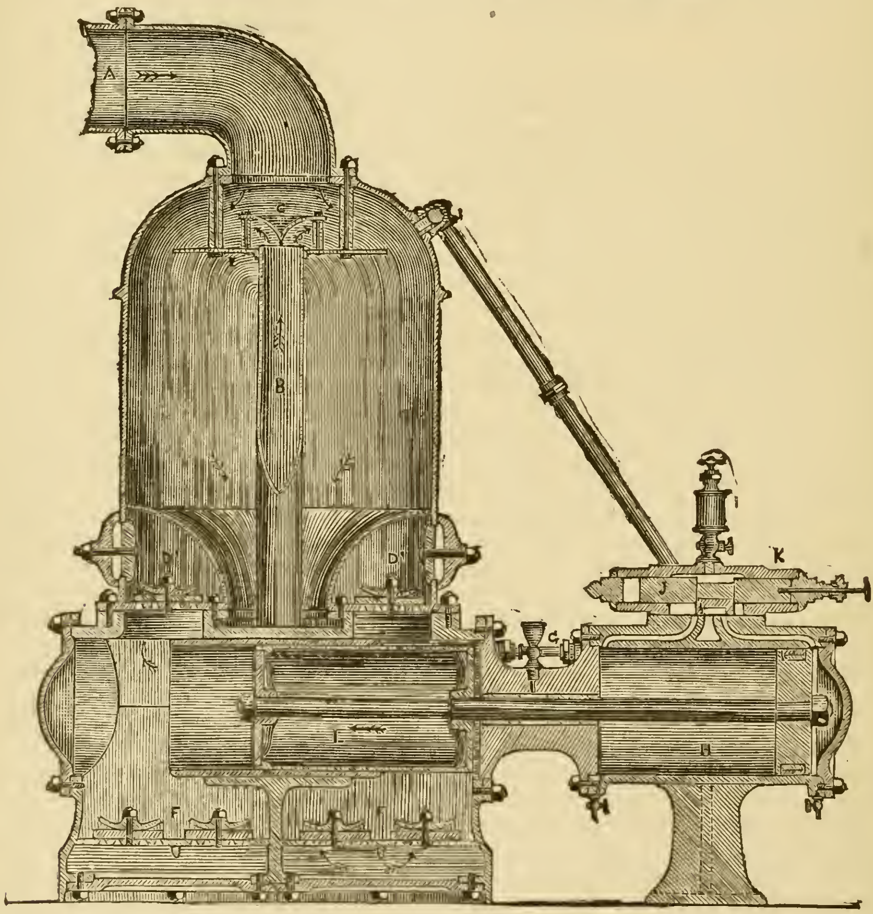
There are two general systems of using steam in engines that give two divisions of steam engines, known in common parlance as "high pressure" and "low pressure" engines. These terms are, however, not only indefinite, but calculated to convey a wrong idea. To the unpractical inquirer the term "high pressure," as contradistinguished from "low pressure," implies the use of steam at a much greater energy per square inch than "low pressure," and suggests possible greater danger. But the fact is that there are "low pressure" and "high pressure" boilers which carry steam of the same general pressure. A "high pressure" boiler is not necessarily a dangerous one, neither is a "low pressure" boiler necessarily safe.

The proper distinguishing terms are "non-condensing" and "condensing" engines, the "non-condensing" corresponding to "high pressure" and the "condensing" to "low pressure."

When the steam used in the engine cylinder has performed its work of driving the piston from one end to the other it is allowed to escape either into the atmosphere, or into an exhausted receiver known as the "condenser." The "non-condensing" or miscalled "high pressure" engine exhausts its steam directly into the atmosphere, striking against it with such force as to produce a noisy concussion, heard at every stroke of the piston, and particularly noticeable on locomotives on starting and while getting under way. The extent of this force can be readily understood when it is remembered that the atmospheric pressure is nearly fifteen pounds to the square inch. It is evident, then, that the productive and useful energy of the "non-condensing" engine is shorn of just that amount of effectiveness. At first sight it would appear to be demonstrated that the "non-condensing" engine would, of course, be more expensive in use than one that did not have this drawback; but this is not necessarily so, for some other elements than those of the direct effectiveness of steam and the absolute cost of its production are concerned in the problem of how to produce and use steam power economically. If this were not so there would be comparatively little advantage in the variety of styles of steam engines; and yet it is apparent to the most cursory observation that steam engines must be designed for their special place and work as much as road vehicles should be—the coach, omnibus, and truck team having only the most general characteristics in common with the buggy, racing gig, and bicycle.

The "condensing" engine, on the contrary, exhausts its steam into a vacuum formed by exhausting the air from a vessel called the "condenser." When the exhaust steam from the engine has done its work of pushing the piston in one direction it passes instantly into this vacuum, where it is met by a jet of cold water, that resolves the steam into its liquid form of water, thus reducing its volume from about 1,700 to 1, that being the proportion between water and steam as to volume, and at the same time reduces its temperature to about 100° Fah., making it useful for re-supplying the boiler. The addition of the condenser, air pump and their appurtenances, renders the condensing engine more complicated and cumbersome than the non-condensing engine, and somewhat limits its use, and greatly adds to its first cost. These facts have confined the condensing engine to large machines on land, or on steamships of considerable tonnage. But there have been several attempts to make a combination of the non-condensing and condensing types without the large expense of original construction. One of the most successful of these attempts is herewith represented. It is the invention of R. W. Hamilton, a well-known mechanical engineer, and is manufactured by Sawtelle & Judd, Hartford, Conn. The accompanying engraving is a vertical section of the

HAMILTON INDEPENDENT AIR PUMP AND CONDENSER.




The exhaust pipe, A, has valves to connect or disconnect condenser from engine, making it a condensing or non-condensing engine, without stopping the engine.

When the condenser is required to be used, the injection valve is opened, and steam is let on to the steam cylinder of condenser to operate air pump. When sufficient vacuum is formed to lift the water in injection pipe, B, the water is carried up through pipe B to the deflector, C, and falls on the perforated plate, E, to distribute the water in the condenser; at the same time the exhaust steam is being drawn by vacuum through the exhaust pipe, A. The contact of the steam with water at once condenses the steam, which water falls into the cone (shown by direction of darts) to the bottom of the base of the condenser. The vacuum formed by the plunger of the air pump, L, operated by the steam cylinder, H, lifts the water from the lower part of the base of the condenser through the induction valves, F, into the space around the plunger, L, and on the return stroke of the plunger, L, is forced up and out through the eduction valves, D, to the waste pipe.

The piston in the steam cylinder, H, is operated by the piston side valve, J, in the steam chest, K, the whole governed by a tappet rod G, which determines the stroke from both steam piston in cylinder, H, and air pump plunger, L, giving it a regular and positive stroke, which is at all times ready to start without reversing the valves.

### THE COMPOUND ENGINE.

This comparatively modern type of steam engine differs from ordinary engines in having two or three cylinders, the steam from one exhausting into the next. The principle of the compound engine is the reduction of steam heat by radiation in a single cylinder. As generally used, steam is greatly expanded in the single cylinder, this expansion necessarily greatly reducing its temperature and cooling the cylinder between each stroke. In the compound engine the steam in the first cylinder runs nearly full stroke, and expands so slightly as to hardly affect the cylinder. From the first cylinder the steam enters the second cylinder, which is very much larger than the first cylinder, so that it operates expansively in this second or supplementary cylinder. In some situations, particularly on ship board, the compound engine is considered very economical.

### THE "HORSE POWER."

There is another vulgar error relating to steam engines and their work, and that is the common style of talking of "horse power." This method of defining the energy of steam was originated by James Watt, who had no other handy and available comparison than the work done by Cornish horses in raising coal, water, and men by means of a winch, or pumps, from the depths of coal mines. As his engine was primarily constructed to supersede or to compete with the work of horses, it was but natural that he should use their animal powers in contrast with his atmospheric engine. He estimated, from experiments, that a good horse could raise over a single pulley 33,000 lbs. one foot high in one minute, and this became the unit of estimate in the power of engines—and also of the steaming quality of boilers. But modern engineers, although employing the term, define it, at least mentally, in the consideration of 1, pressure per square inch on the piston; 2, area of the piston in square inches; 3, velocity of the piston. If nearer approximation is desired other considerations are taken into the problem, as the point of cut-off of the admission of steam to the cylinder, the character of the valve gear, the amount of clearance, the diameter and weight of the fly wheel, and other items relating to the normal and useful quality of the steam, etc. For general and rough estimates, however, the practical engineer conveys to a brother engineer an idea of the power of an engine by stating the boiler pressure, diameter of the piston and length of stroke.

When approximate and nearly absolute results in the use of steam in the engine is desired the indicator is attached to the steam engine cylinder. This is a small steam cylinder that takes the steam at the same instant the engine piston takes it and, of course, with the same energy, and while the engine piston is performing its work the miniature piston is recording it by means of attached mechanism, on a sheet of paper. By having one of these indicators at each end of a cylinder, the reciprocating action of the steam in the cylinder is simultaneously recorded in the form of a diagram that by right lines and curves gives the data of the admission of steam, the point of its cut-off, the amount of back pressure in its emission, and the action of the combined induction and eduction of steam to the piston. Very accurate mensurations of the work have been made by means of these little instruments; for they seldom have a diameter of cylinder of more than a single square inch, although the engines they may be used upon may vary from 4 or 6 inches diameter to 80 or 100 inches; and while the stroke of the indicator is only 3, or, at most 4 inches, that of the engines may vary from 12 to 140 inches.

By the use of this delicate machine the real power of an engine may be determined, and it can also show the amount of work performed by the engine. Its use is the determination between "nominal," (calculated) horse power and "indicated," (real) horse power; statements of which are sometimes made that vary to a very marked extent.

It may be that instruments will sometime be constructed which will give diagrams of the performance of steam in the cylinder of the full size of the steam engine cylinder, or perhaps enlarge them. If this could be done, either on full size, or on a magnifying scale, the deductions of the indicator might be made absolute and perfect. As it is, all the operations noted are reduced to a very low proportion, and even then not to scale, as the same indicator that records on its "card" the work of a portable engine of 4-inch piston and 8-inch stroke, is used also to record the action of a 110-inch piston and 144-inch stroke, the calculations in both cases having to be reduced to the dimensions of the indicator.

### SOME PECULIAR ENGINES.

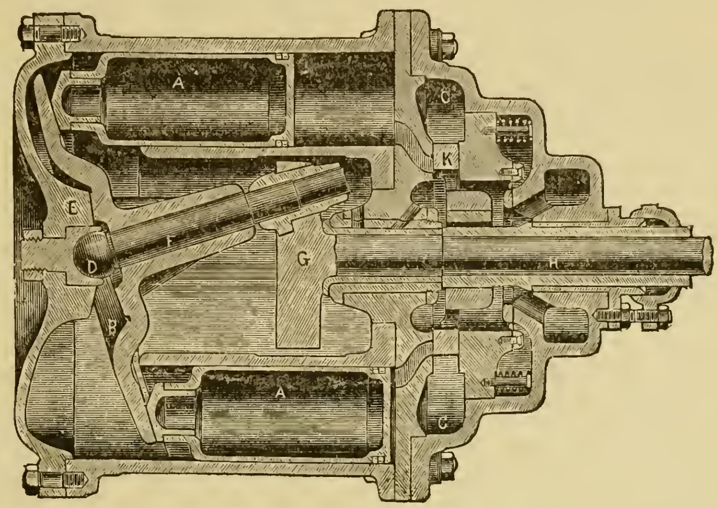
The practice of running engines at very high speeds has received great encouragement from practical engineers within a few years. Theoretically there is much in favor of it. It is certain that the quicker the steam performs its work—the less time it is exposed to cooling influences—the more useful energy will be obtained. It is certain, also, that velocity when combined with heavy rotating bodies is itself an element of power. On these bases the principle of high speed engines can be very strongly defended. But such engines need careful attention and must be very exactly built and the parts finely balanced. A piston speed of 720 feet per minute is not unusual with this class of engines; and it is certain that whatever may be urged against their general use, they have proved valuable in many instances. Some engineers go so far as to assume that they will eventually become the popular type for stationary engines. The Porter-Allen, Buckeye, and Hartford High Speed are well-known types of swift running engines.

A very peculiar engine is that known as the "Colt's Disc Engine," made by the Colt's Pat. F. A. Co., Hartford, Conn., a vertical section of which is appended.

This engine is chiefly valuable because of the small space it occupies, and because its working parts are all encased and thereby removed from chance of accidental injury and ignorant tampering. It has other merits which appear in its use. In form it may be likened to the chamber of a six-shooting revolver, there being six cylinders arranged longitudinally and horizontally around a central shaft. The main divergence in this comparison would be that while the pistol chambers revolve around the pin or stud in the engine, the chambers or cylinders are fixed and the pin, stud, or shaft is made to revolve.

In most steam engines, since the first attempts of Watt, the steam impels the piston in the cylinder in both movements, driving it not only from the hither to the thither end, but *vice versa*. In the Colt Disc engine the steam acts only in one direction on the piston, sending it back from what may be considered the front of the cylinder. This engine has no piston rods, the connection being the reciprocating—or rather the thrusting—motion of the pistons, and the rotary motion of the central shaft being made by a singular contrivance that gives its name to the engine as the "Disc" engine. This is a disc large enough to cover the entire circuit of the grouped cylinders, and sustained by a ball and socket joint at the centre of its back. It is evident, therefore that the successive thrusts of the six pistons against its surface near its rim will impart to it a motion of rocking on its centre, a swinging, or "wabbling" motion that may be illustrated by poising a dinner plate on the point of the finger and then giving it a push or touch downward on one side. This disturbance of equilibrium will be continued in a wave-like form entirely around the edge of the plate. Now it is evident that if this wave-like motion can be controlled as to extent it may become a mechanical success. This is what this Disc engine does. The tipping of the disc around an entire circle would make a projection or continuation of its centre describe an entire and perfect circle. This is utilized as a crank connection by a universal joint, a crank that can have no dead centre, as the entire rotation is divided into six parts instead of two as in the ordinary reciprocating engine, so that tho engine is always ready to start. The fewness of parts adapts it admirably for yacht, launch, and other purposes where great power is required and little space can be accorded.

THE COLT DISC ENGINE.




The pistons, A, are plungers, one end terminating in a blunt cone which bears continuously against the periphery of the disc, B. They are single acting, being subject to steam pressure upon the flat end only. Steam is admitted successively to the six cylinders from the steam chest, C, three pistons being constantly in action at different points of the stroke. The crank pin F is fixed in the centre of the conical disc B, the rolling motion of the disc causing the pin to describe a circle, and by means of the crank G, imparting a rotary motion to the shaft, H. The shaft, H, passes through the centre of the steam chest and carries an eccentric giving motion to a circular valve that slides on the face of the combined cylinders, opening and closing them as one describes a rotary and the other an eccentric vertical motion. The valve is shown in the engraving as K, the eccentric motion of which alternately opens and closes all the steam ports, successively admitting steam to the cylinders, from which it again escapes to the exhaust chamber, M, formed by the inside of the valve ring, and thence through openings into the body of the engine, and is finally discharged by the exhaust pipe, N.

The compactness of this engine makes it very useful for propelling yachts, launches and other small vessels using the screw. It may be placed very close to the screw and very near the keelson. For these marine purposes the engine is fitted with a reversing motion, which, by a single movement of a hand lever will instantly reverse the action of the engine even when running at full speed.

The Baxter Portable Engine is a very fair type of engine that is in great demand in this country for "opening up" new means of individual wealth and developing sections of unused national domain; and also for combined boiler and steam powers in small manufactories. The peculiarities of the Baxter engine are not so much its portability as the fact that its steam cylinder is jacketed with boiler pressure steam at all times. This fact—arresting condensation—makes this a very economical small engine.

In this engine the working cylinder is introduced into the boiler and all the boiler—steam—heat envelopes the cylinder, absolutely preventing the access of atmospheric or outside air to the cylinder, so that the steam at its first pressure from the boiler, does its work without the possibility of radiation and loss; there being no conducting steam pipes between boiler and cylinder. The fact of its compactness—like that of a kitchen stove—and its excellent arrangements of supply pump and blow-off that secure it from explosion through carelessness, make it a favorable type of the portable engine.

### MACHINE TOOLS.

The improvements made in tools during the last twenty-five years are most noticeable in those for manufacturing, although much has been done in the production of hand tools. In this latter line, the improvements are felt more by operative mechanics than by the general public. For the people generally, the improvement has been in the way of giving the agriculturist and the general farmer better tools and adapted appliances, specimens of which are to be found in every town and in every decently furnished hardware store.

But, among mechanical producers, the improvements most to be noticed are those in the production of manufactured articles, and the means for their production. In this department of endeavor it is evident that the manager of machinery has an advantage over the manipulator of material; the hand worker being merely an assistant to the machine manager. The machine does the work, and the hand workman furnishes the means. This is not the proper arrangement, and will be rectified as soon as the limit of mechanical production is reached.

But the products of the mechanical workman show themselves in the results of the machine. Years ago it would have been impossible to show any proper result from the hand work of the individual workman as compared with the finished production of the machine made by the hand worker. As a general principle it may be stated that "all perfection in mechanical work comes from hand-skilled labor." This acknowledged, it is easy to see that the skilled workman is at the head, and his productions comprise all there is of improvement in mechanics.

But some of the improvements made by intelligent mechanics are of very great value. The lathe has been so improved that the perpetual trial of the calliper is not absolutely necessary; only the wear of the point of the tool is to be attended to; the lathe itself, with its carefully scraped and adjusted ways, shows a record of exactness that would shame a mathematician. How different from the time when lathes and their ways and carriages were seated and adjusted by grinding, using emery or sand!

The planer is a fixture as regards exactness of level. The bed is solid—so solid that a weight of five or seven tons does not bring its level down a fraction of an inch, and its upright and tool bar so stiff that the product of the work will not show a hair-line under the testing straight-edge.

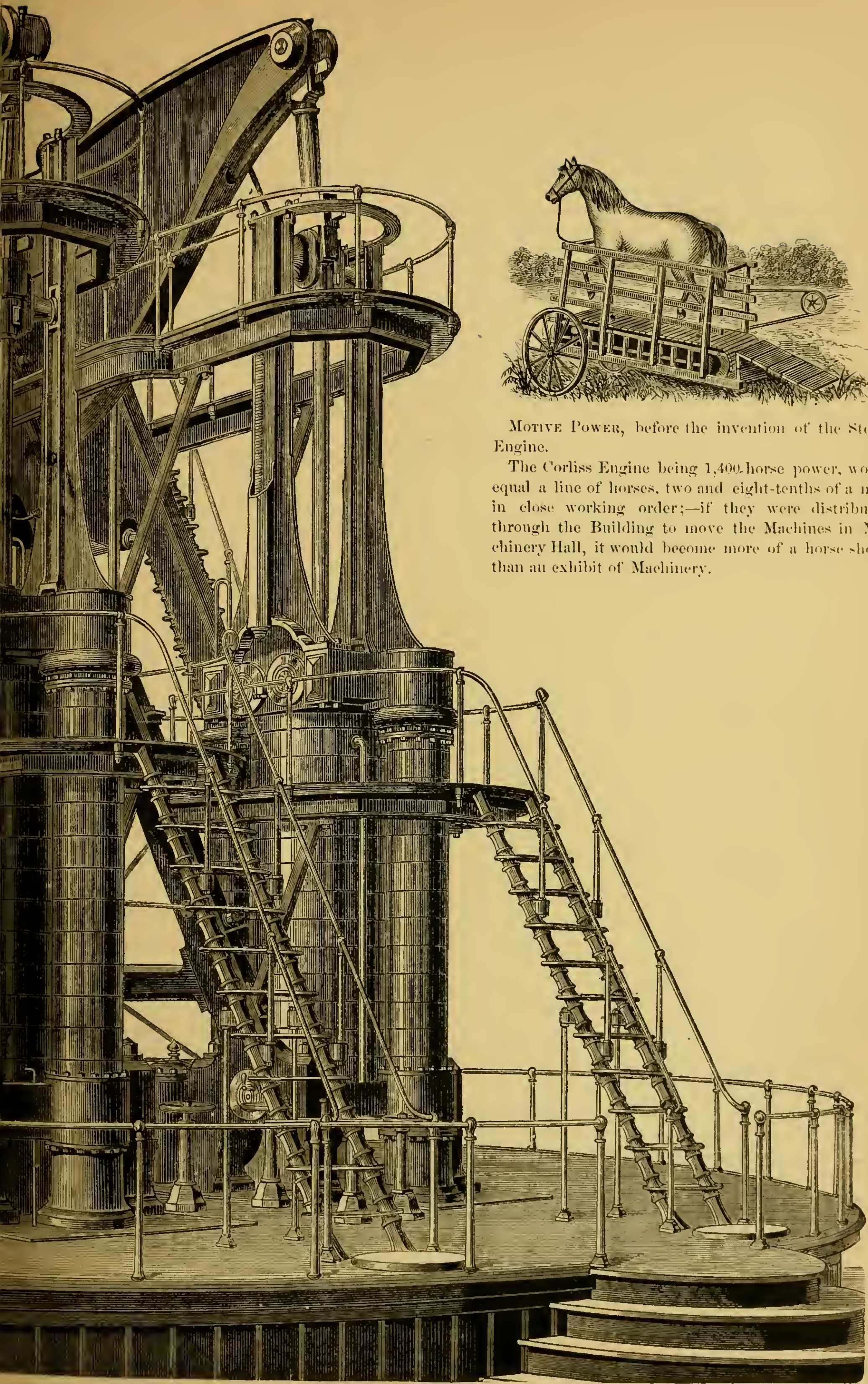
So much for exactness. How is it about convenience? Take any good, well-managed manufacturing establishment that makes the production of machine tools a specialty. There is not a movement made, or a method used but must be subjected to the most exactive tests, and they always meet the tests. The rapidity of work on the modern planer and the best style of lathes is equaled only by the exactness of the production. The introduction of the rotary cutter—a modification of the saw—on traversing platen machines has greatly advanced the production of tools and machinery and appliances of useful industry, and has greatly improved, also, the quality of the work seen in the milling machine, the die-sinking machine, the profiling machine, and all exhibits of the rotary cutter. Most of our taps and our reamers are scored by these means, and there are numberless methods of use of a very plain system that have given a spur to the mechanical improvement that makes the methods of forty years ago appear like the legends of an unrecorded age.

What we formerly worked by hand we now accomplish by machinery, and in most cases do it better by the modern method. A prominent manufacturer said, recently, that he had constructed a machine for a sewing machine maker to drill holes in one piece of his machine. The new tool saved him its cost—$2,000—in one year, and gave better results than his hand labor.

### DESCRIPTION OF THE CORLISS ENGINE WRITTEN AT THE TIME OF THE CENTENNIAL EXHIBITION OF 1876, AT PHILADELPHIA, PA.

This engine stands as a great double-armed giant, quietly—almost noislessly—and yet effectively throwing its exhaustless powers upon the heavy beltings, and thence to the innumerable shaftings—main and


GEO H CORLISS
PROVIDENCE R



Motive Power, before the invention of the Steam Engine.

The Corliss Engine being 1,400-horse power, would equal a line of horses, two and eight-tenths of a mile in close working order;—if they were distributed through the Building to move the Machines in Machinery Hall, it would become more of a horse show, than an exhibit of Machinery.

auxiliary—that speed ten thousand machines from 9 A.M. to 5 P.M. daily. We can not be minute in our description of this mighty motor, but will give a few prominent features that we trust will interest our readers. The engine is placed in the transept near the center of the Hall, and where the building is 70 feet from the floor to the top of the ventilator. The gear fly wheel connects underneath the floor with the main shaft, which is 352 feet long, running crossways of the building. At the ends of this shaft, and at two intermediate points, connected with it by nests of beveled gear six feet in diameter, are shafts 108 feet long, running at right angles with the main shaft and parallel with the Main Building, to points directly under the ends of the separate lines of overhead shafting. Under each end of these overhead shafts are the main pulleys, eight in all, seven of them being eight and one nine feet in diameter, and each thirty-two inches across the face. There is also an extension of the main shaft under the floor, to reach the Hydraulic Annex; where a pulley six feet in diameter carries a belt two feet wide to connect with the overhead shafting of that department, for driving the various blowers, rotary pumps, &c. By this arrangement each pulley is directly under the end of a distinct main shaft overhead in the Hall, with which it is connected by a double belt, thirty inches wide and seventy feet long—an aggregate of twenty-two feet in width of double belting being required to transmit the whole power of the engine,—and eight of them in a position to drive a straight line of shafting 658 feet long, and one about 150 feet for the pump annex. Thus there are 784 feet of main shafting, four nests of beveled gear, (three in a nest, and each gear six feet in diameter,) and the large gear connecting with the gear fly-wheel underneath the floor and completely out of sight, while the main pulleys extend above the floors less than half their diameter. The main belts, instead of being an eye-sore and in the way, as is too often the case, pass through the Hall in out of the way places, and are inclosed in glass apartments eight by six feet in size, so as to make a proper exhibit of the belts.

The engines are what are known as "beam engines" of the Corliss improved pattern, with all the latest improvements, and nominally of 700 horse-power each, or 1,400 horse-power in both, though this can be increased even to 2,500 horse-power should occasion require. The cylinders are forty inches in diameter, with ten feet stroke. The engines are provided with air-pumps and condensing apparatus, and are intended to work with from fifteen to eighty pounds of steam, according to the requirements of the exhibition.

The gear fly-wheel is thirty feet in diameter, two feet across the face, and has 216 teeth, the wheel makes thirty-six revolutions per minute, and the periphery moves at the rate of about thirty-eight miles an hour. The wheel is between the two engines, and connects with gear under the floor. The crank-shaft is nineteen inches in diameter, and twelve feet long; forged at the Corliss Steam-Engine Works. The "bearings" for this shaft are eighteen inches in diameter and twenty-seven inches in length, and look large enough almost for a good-sized boy to crawl into and cuddle down. The cranks are of gun metal, highly polished, and weigh over three tons each. The walking beams are of new design, and are nine feet wide in the center, twenty-seven feet long, and weigh eleven tons each. The connecting rods are about twenty-four feet long, and are made of horseshoe scrap iron, that being considered the best iron that can be obtained. (Ninety-six hundred horseshoes were used in making the connecting rods.) The piston rods are of steel, six and one-fourth inches in diameter, and the velocity of the pistons is 720 feet per minute.

The large gear with which the gear fly-wheel connects is ten feet in diameter, and is a solid casting of 17,000 pounds. The height of the engine from the floor is thirty-nine feet, and every part is accessible by means of iron staircases and balconies, which add much to the artistic beauty of the design. The weight of the engine and its appurtenances amounts to 1,383,264 pounds, making sixty-one car loads of 22,676 pounds each. With regard to the foundation to support this immense weight and the connecting shafts, etc., we must be content with the proffered information that more than two thousand tons of masonry and building material have been carefully laid beneath the aisles and avenues of the great hall to hold in secure position the several bearings upon which are continually revolved not less than 365,000 pounds of shafts, gears, and pulleys, placed between the engine and the main belts attached to the overhead shafting.

The engine now runs 600 feet of main belting—viz., 88 feet of 24-inch, and 528 feet of 30-inch. Of main shafting, it runs over one and a half miles. Add to this the side shafting and small belting and shafting, the whole may be multiplied by five, and then run short of the true amount.

It has now been running for five months, and shows not the least imperfection, and without the slightest interruption. It is the design and construction of Geo. H. Corliss, engineer, and is his individual property, furnished by him free of all expenses and generously run at his individual cost. When the exhibition closes, he will take it back to Rhode Island and hold it until an improved condition of manufacturing business shall create a demand for such a power.

Near this great motor is a large gear cutting engine, also the design of Mr. Corliss, constructed at an expense of $4,000, for the purpose of securing perfect accuracy in cutting the bevel gear. It is used in this work, and is regarded, especially by foreign engineers, as one of the notable features of the exhibition.

The extent and capacity of the Corliss Steam-Engine Works can be best appreciated by considering the fact, that the Centennial engine was constructed from the crude materials—transported—set up, and put in operation in the short space of nine months and twenty-six days. This engine is now running the Pullman car works at Chicago, Ill.

## CHAPTER VII.

### CONCLUSION.

To understand fully our indebtedness to the inventors and improvers of the steam engine, we must compare the past with the present. We must remember the North River sloops, the slow ocean packet ships, the lumbering coach; then the canal boat, the horse boat, the horse railroad; followed, but not yet entirely superseded, by the steamboats of Fitch, Fulton, Stevens, and a hundred others—each an improvement on the last—until months are crowded into weeks and weeks into days. If it is true, as some have said, that the duration of human life is less in each succeeding generation, it is incontestable, on the other hand, that the amount possible to be accomplished by each man in the same amount of time is increased many-fold. We have shown what has been done by steam; but are we now to stop and fold our hands at the request of the few old fogies who have been hurried along against their will, and now wish to sit down and take breath when the great work has but just commenced? No! American genius is the engineer of this locomotive, "Progress;" his hand is on the throttle-lever, which he opens wider each day. Conservatism may act as brakeman, but has no power to stop the train unless the engineer aid him. His bright, clear eye looks out upon the straight track—for the path of progress is only warped by foolish or selfish men—and conservatism may *brake* up and retard, but not stop the train. It will, it is true, take more steam to draw the load, while old fogies thus act as a drag, and they may rest assured that their action only renders the course of progress more dangerous, but will never stop it.

Lay down this vain opposition, then, and add your voice and your purse to aid the advance of steam; send your horses into the country, or retain them only for pleasure rides of invalids; pave your streets with iron, and harness steam to your drays and cars. We may not live to see it, but it is our firm belief that the time will come when the foolish excuse that steam will frighten horses in our cities will be no longer urged, for there will be no horses to frighten. You say that we are enthusiastic; so was John Fitch; does it then follow that he was wrong? You try to urge that there is more danger in steam than by the old mode of travelling, but this has long ago been proved false; and if there still are accidents from boiler explosions, it is your fault that they have not long since ceased. Pass a law in each state providing for the inspection of all steam boilers, and the examination of all engineers, and impose a heavy fine on all who hire an engineer who has no certificate. Do not make this a political movement, but see that the board of inspectors is composed of experienced engineers, men who can themselves pass an examination of the most strict nature; and bear in mind also that steam requires close attention, and that there is not one man in a hundred that can have the care of it, and at the same time have his mind distracted by other duties, without endangering the whole neighborhood. Powder mills are always located apart from other buildings, for a careless act would scatter destruction around; well, some of the boilers in New York at this present moment are worse than powder magazines, and yet they are located in the most densely populated parts of the city, and beneath sidewalks trod hourly by thousands. The engineer (?) saws wood, grooms horses, or works at the bench, while his pump clogs, and the water gets low in the boiler; or, interested in other work, he forgets to put the pump on, and soon after—longer, perhaps, than he is aware—he lets in the water, and wakes to find himself in a neighboring yard, or never wakes to see the effect of his employer's false economy. Under such management, who can wonder at the accidents we read of weekly; or, rather, what man conversant with the laws of steam does not wonder that there are no more "terrible calamities" to be recorded?

It is comparatively easy to understand the great advantages that have accrued to navigation and land transportation from the use of steam, for its effects are constantly before our eyes; but improvements from the use of steam in stationary engines are less apparent, although full as great. Even in the immense manufactories of Manchester and Lowell, where the water power seems almost unlimited, we find the steam engine at work; and all the water power of the United States combined would not be sufficient to carry out one branch of manufacture in all its details. If we now compete with foreigners in the manufacture of cotton goods, in spite of the low price of labor abroad, it is not only owing to our great improvements in cotton machinery, but also to the competition of our steam mills. And the steam press! Tiny jets of steam puff forth from the offices of our smallest job printers, and ponderous engines work the six, eight, and ten cylinder presses of our large dailies. The *New York Herald* had facilities as long ago as 1860 (which were then considered as marvelous) as follows: two engines to do the press-work: one built by Hoe is a beam engine of twenty-five horse power, the other is an upright engine of fifteen horse power, making in all forty horse. With these two engines they consume about one ton of coal per day, and throw off an average of 75,000 impressions. The office is, however, capable of doing much more than this, its utmost capacity being 48,000 impressions per hour. The engine rooms are very well fitted, and have two of Woodworth's donkey pumps; the one to supply the boilers with water, and the other, to be used in case of fire, is connected with hose in every room of the building.

The first steam mill that was erected in England was mobbed by the populace. They feared this giant competitor; they were afraid it would take food from their mouths; and we are sorry to say that this old feeling of the laboring classes is not yet entirely eradicated; educated Americans, who should know better, can yet be found to condemn machine labor. Last year Broadway was swept by a machine that would in time have been replaced by steam, but New York has taken a retrograde step, and politics have so strong a hold upon her citizens that progress must bide her time. Has the introduction of machinery hurt the laboring classes? That is the question! Are our laboring men worse off than before the introduction of steam? Look at the facts and the answer is plain. A few coachmen were thrown out of employment to make room for hundreds of employees upon the railroad, to say nothing of the thousands benefited by their construction, and that of the cars, locomotives, station-houses, etc. A handful of weavers and spinners have been temporarily removed, to be reinstated, with thousands of their fellow men and women, at full as good pay as before. Head has aided hands everywhere, and those who have kept up with the age of improvements have been, as they should be, the ones to profit by its advantages. But great as have been the improvements in our stationary engines, there is still much to do; we are not, in fact, living up to what we already know. The ordinary average of duty performed by our best stationary condensing engines is one horse power to four pounds of good coal consumed, while in marine engines it requires the consumption of four and a half pounds to the horse power; and yet engines are running that consume but two pounds to the same work. With these facts before their eyes, men continue to purchase the former, instead of looking for an improvement upon the latter; for even these results can be improved upon, as in our best boilers there is much of the combustible gases wasted, and much of the water evaporated into steam is condensed before it reaches the cylinder; any perceptible heat from the engine while working is, of course, so much loss of fuel. Bearing this in mind, enter an engine or fire room, and you will realize the loss from that source alone.

The first difficulty is being fast overcome by admitting atmospheric air above the fire, which unites with the gases as they rise, and furnishes the oxygen necessary for their combustion; it is now necessary to get rid of the heavy, incombustible gases, and this will soon be done. The radiation of heat can be prevented almost entirely by inclosing the boiler, cylinders, steam-pipes, etc., in some non-conducting substance; this is technically called "*jacketing.*" Other improvements in the steam engine are being made every day, and we believe that the consumption of only one pound of coal to the hors epower will soon be accomplished.

In view of all the facts that have been adduced to prove that the steam engine is the best of all motors, can it be possible that there are still those who are sceptical on the subject of its utility? Alas, yes! You will find them among those who object to the use of steam in our streets to replace the horse cars; men who believe that new inventions must necessarily be humbugs, because in a few instances they have failed, and who cannot see that the greater number have added to their wealth, their comfort, and their pleasure. The greater number, say we? We might have said all; for if the first invention fail, it paves the way for another and better, and many of the failures of inventors stand as sign-boards to show the false paths. You will find these incredulous men in the same position to-day as were the throng of spectators who stood in Brown's ship-yard when the North River was fired up for the first time. loudly calling it "Fulton's folly." Its great success soon quieted them for the time, but it was for a time only. A succession of surprises from that day to this should, it would be thought, have forever quieted them, but they "still live," and will only accept progress as a fact after repeated successes make it impossible to doubt; meeting each new plan with the same incredulity.

In speaking of the accessories of the steam engine, there is one point we omitted: many boilers are unprovided with steam gauges. In a conversation with a proprietor of a steam engine some time since, we asked him why he did not have a gauge upon his boiler. "Oh!" said he, "that is all nonsense; my safety-valve is weighted at one hundred, and my boiler would easily carry twice that steam. I have been without one for three years, and don't need it." We asked him if his engine was always competent to do his work, and if the latter was always constant. "Yes," he replied, "the engine will always do the work, but it is just all it will do. As for the work being constant, it is far from that; some days we do not run but half of our machines, and then the safety-valve tells its own story by 'blowing off.'" "Yes," we replied, "and it tells another story, which is 'loss of fuel.' Had you a steam gauge, the engineer would know how to fire, and in less than three months you would be able to pay for a gauge out of your savings." "Pooh! nonsense," he replied. Insisting upon the truth of what we said, we prevailed upon him to try it for a month with, and without a gauge, and so well satisfied was he with the result that he now says a gauge is worth two hundred dollars per year to him. This may have been an extreme case, for the engineer always knew when he came in the morning what machines were to be run, and he soon had an exact knowledge of the amount of steam required to drive them, and, therefore, regulated his fires by the gauge. Gauges will get out of order, we know, but they must be tested at least every three months by some standard, and repaired if wrong. Who wonders if so delicate an instrument should get out of order under one hundred pounds pressure for two or three years? and yet we can point to a gauge in use in this city that has not been tested for four. It is unnecessary to add, the proprietor "don't believe in gauges;" he probably expected it to last a life-time.

With regard to low water detectors, that whistle when the water is dangerously low, they must be used with great caution, for if out of order they would be a source of positive danger by the fancied security of the runner. After all, the only safeguard is a boiler in good order, and a competent engineer to take care of it; be sure on these two points, and nothing is better than steam to do your work. Those owning small engines object to paying the price of such men. Is it not better to pay more per day for absolute safety than to risk an explosion that will destroy all your property, and possibly your life and the lives of your workmen? If your work is not sufficiently profitable to pay a competent man, *sell* your engine and run your mill by horse power; better have a *mule* to turn the driving wheel than run the engine. But it will afford it; nay, in nine cases out of ten a good man will save more than his salary amounts to in fuel and repairs alone.

And now a word to engineers. You who are upon our steamships and locomotives think that such a law would be of no benefit to you; but you are very much mistaken; once passed, it would give employment to hundreds that are now competing with you for a position that is only sought because it offers better wages than stationaries can under the present system; under the same pay, men would prefer to run land engines, and be near home. Therefore, it is a duty you owe yourselves to insist, wherever you exercise the rights of suffrage, that your representative shall advocate such a law; make it the *sine qua non* of your vote. And you, engineers in name only, if you wish to retain your present positions, study your duty; learn why you do what you now mechanically perform; find out what pressure you are carrying, for yourselves, and do not trust to the marks on your safety-valves; read works on steam, and satisfy yourselves if they are true by, as far as in your power lies, testing them, for all that is printed is not necessarily true, as you will very soon discover. Above all things, be one to form an engineers' society, and discuss with men of experience the knotty points which will rise in your mind when you once begin the study of this potent vapor.

We cannot finish this article without referring briefly to another motor, which has for the last four or five years attracted some attention: we allude to the caloric engine. Mr. Ericsson, of whom we have already spoken, is the inventor of this machine. The power made use of is the expansive force of heated air. For small engines this motor has been used with success, but in all Mr. Ericsson's experiments on a large scale it has failed. As there is no danger of explosion from the lack of water, the caloric engine has been of value on the southern plantations, as any one can run it, it being only necessary to make a fire, and see that the machine is oiled and kept in repair. We do not believe, however, that it will ever supersede steam as a motor, even for small engines. Since Mr. Ericsson's invention, others have followed with various improvements, and much ingenuity has been displayed upon the subject; we hear occasionally of some great success of a caloric engine, but it never results in any thing permanent. The details of the caloric are different from those of the steam engine, and the heavy boiler is done away with, but they are not as cheap if the cost of the boiler be excepted, and are much more liable to get out of repair; still, if properly taken care of they are useful, as we said before, in situations where but little power is required, and water scarce. Mr. Holly, so well known as "Tubal Cain" of the *New York Times*, says, in speaking of the caloric engine: "We only wish it was a better rival of steam in every particular, that it might compel the makers and users of boilers to employ better materials, better forms, and greater care in the management of the subtle motor—steam. And as its mechanism improves, as we believe it will, to some extent, year after year, it will better serve the public by compelling us to improve the smaller varieties of the steam engine, which, we believe, can also be made perfectly safe. The hot-air engine requires no constant or professional attendance, and for this reason is a valuable motor in cases where an occasional or auxiliary power is required. And for small purposes, the saving of engineer's pay more than balances the increased cost of fuel and repairs."

Undoubtedly small steam engines and boilers can be made perfectly safe; in fact, they should be the safest, and will be so, when the public will not look to the mere first cost alone, but will only buy engines of the best builders, and pay a fair price therefor; another result that we hope to see brought about by an inspection law. Nor is this by any means a small matter, for the unthinking man would be astonished at the amount of small stationaries that are now running throughout the country. In New York there are engines or boilers in every street; at our hotels and public buildings, in our printing offices, carpenter shops, as well as in all the larger manufactories and machine shops, engines of from two to five hundred horse power are daily running. Machinery of all kinds is driven by steam, from the large lathes and planers of our machine shops to the sewing machines of the clothiers; manufacturing crinoline in one place, and forging huge masses of iron in another, the busy hum of steam-driven machinery resounds on every side. Stand and look at the ten-cylinder press, and think of Franklin working at his old wooden one. Compare the speed of the former with the country press of only a few years back, if you would realize this great improvement. Has this hurt the printers as a class? Figure up the gross amount now paid to compositors, and compare it with the amount paid fifty years ago before you answer. Philadelphia is known as a manufacturing city, and one which is probably destined to be the greatest in this country. To what does she owe her prosperity? To the stationary engine, for she has no water power. We have already said, and we repeat, that imperfect though the steam engine may still be, it is by no means certain that water power is cheaper, and there is one disadvantage in the latter that is often overlooked, it is that of monopoly. The rich company who own the water power let it out at their own price, for there is no competition; but with the steam engine it is very different; if the price asked for power by your neighbor be too great, you can readily purchase an engine of just the power you require, and run it independently. But the greatest advantage of the stationary engine is that it can be used by the manufacturer at the door of the consumer, and the goods produced will be thus under his direct inspection.

Steam enters into the manufacture of every thing around us. The paper we write upon was dried by steam, our tin paper-cutter was rolled by steam, the chair we sit upon was turned and bent, the carpet was perhaps wove or at least dyed, and the wood work of the very room we are in, were all done by steam. Steam can warm our dwellings, and prepare our food. It tunnels mountains, and makes pins, cards, spins and weaves, coins our money, braids, twists, sews, washes, irons, and, in fact, enters into every branch of industry.

# COTTON MANUFACTURES.

## CHAPTER I.

### ORIGIN—HAND WORK—INVENTIONS.

The use of cotton as a material for human clothing has been known since remote ages, not only in Asia, but among the ancient inhabitants of America. The kind of cotton used in the United States is a native of Mexico, and it was the principal material for clothing in use with the Mexicans at the time of the discovery of this country. They had neither hemp, wool, nor silk, but they wove the cotton into large webs, as delicate and as fine as those of Holland. These they ornamented with feathers and fur, wrought into the fabric in the form of animals and flowers. Cortes sent a number of these magnificent robes to Charles V. The art was apparently lost in the strife that followed, but the material transplanted to the United States about the time of the organization of the new government, has become a bond which holds modern Europe in dependence on American industry; a dependence which they would gladly shake off if they could, but which only becomes more hopeless in their efforts to do so. The cotton culture has produced a web which holds the lion in its toils, and his efforts to free himself, gigantic as they may be, only make his impotence more apparent.

The growing and manufacturing of cotton by machine took date from the organization of the United States government, and its progress to 1860 was

| | United States crop. lbs. | Cotton of other sources. lbs. | Total supply. lbs. | Yds. Price, Liverpool. cts. | Yards cloth. |
|---|---|---|---|---|---|
| 1800, | 9,532,263 | 45,671,170 | 54,203,433 | 48 | 162,610,299 |
| 1880. | 2,984,550,000 | 975,250,000 | 3,959,800,000 | | 74,932,000,000 |

The cotton from other sources was that imported into Great Britain from other places than the United States. The increase of supply was neanly all from the United States. The usual weight of cloth being three yards to the pound, the quantity of cotton spun would give in cloth the large number of yards seen in the table. This production employs a vast capital in the transportation, manufacture, and sale of the fabric. More people were, at this time, dependent upon the manufacture for support, than there were in the United States at the formation of the government. In the United States last year, 953,049,105 pounds were manufactured, or equal to 2,859,147,315 yards of cloth, or 59 yards to every person in the Union. The value of this must be $215,000,000. This has been the result of eighty years' progress from very small beginnings, and this marvelous growth has resulted from the extraordinary inventions that have not ceased to succeed each other, and of which we shall give a brief sketch.

The manufacture of cotton by hand originated in India at a time too remote for record, and it has there existed down to the present time in a rude state as far as machines are concerned, yet of an unapproachable and almost incredible perfection of hand production. Ancient writers speak of the "fairy-like" texture. Tavernier, 275 years since, describes a calico that you "can hardly feel in your hand, and the thread is scarcely discernible." The Rev. William Ward states that muslins are made so fine that four months are required to make one piece, which is then worth 500 rupees ($250). "When this is laid on the grass, and the dew is on it, it cannot be seen." These are marvellous productions, doubtless, but they are possible only as a result of the organization of the people. They possess an exquisite sense of touch, and that gentleness and patience which characterize only an effeminate race. Even with them a long training is required in each district to perfect the cloth peculiar to it. This is a kind of industry that does not minister to the wants of a vigorous people in other climes. From India the manufacture spread to China, in the eleventh century, and found its way to Europe with the Mahometan conquests.

It was for a long time supposed and asserted by many philosophers that the Egyptians made cloth of cotton, and the mummy wrappers were asserted to be of cotton. It was not, however, until of late years, that the error was proved. The microscope reveals the fact that the fibres of cotton and flax are quite different. The latter is round and jointed, like a sugar cane, while cotton is flat and twisted. The mummy cloths are all of the first description, and there are no signs of a cotton manufacture in Egypt.

It spread through southern Europe sluggishly, and is first mentioned in England in 1641; but it made little progress until a century later. There were two obstacles to progress—want of the material and want of machines to manufacture effectively. The quantity of cotton imported into Great Britain early in the seventeenth century was about one million of pounds.

Up to the time of the American revolutionary war, the cotton manufacture in England in all its branches was in a very primitive state. At that date a series of inventions and discoveries took place, that rapidly carried the cotton manufacture to a magnitude second to no other industry, and gave it the impulse which has since been rapidly accelerated. The cleaning, carding, spinning, weaving, dyeing, and printing were all conducted in slow and expensive methods, by which a great number of people were required to produce small results. The only source for the raw material was then the East Indies. The quantity derived thence was about 40,000 bales, or 4,000,000 pounds, and this was wrought up by hand processes.

The object in carding and spinning is to draw out the loose fibres of the cotton into a regular and continuous line, and after reducing it to the requisite tenuity, to twist it into a thread. By the early method, after the cotton was cleaned, it was carded between two flat cards held in the hand. A small quantity of the cotton placed on one was, with the other, combed as straight as possible. The fleecy roll that resulted was called a sliver. This roll, or sliver, was then applied to the single spindle, that was driven by a wheel set in motion by the other hand of the operator; as it received a twist, it was drawn out into a thick thread like a candle-wick, called a roving, and was wound on a cop. This roving was again drawn out and spun into a thread. Thus, in two operations, a single irregular and imperfect thread grew slowly in two hands. In this manner all the cotton yarn used was made, in cottages and private houses, mostly by females. The weaving was also done by hand looms; but such was the slow process of spinning, that the weaver's time was largely employed in going round to buy up yarn. They competed with each other in this, and the yarn thus cost more than it should. One fine morning Mr. James Hargreaves determined to emancipate himself from the spinners, by putting into practice an idea that had occurred to him. This was, to spin in his own house, and to make one wheel drive eight spindles, and to draw the rovings by means of a clasp held in the left hand of the operator. That was the first spinning-jenny, patented in 1767. In 1769, Arkwright added the important discovery of rollers, or drawing frames. This was one of the most important inventions. It consisted in causing the roving, on its way to the spindle, to pass between a pair of rollers about four inches long and one in diameter. These held the roving so firmly between them that it could pass only at the speed of their own revolution. From these the roving passed between two other rollers, which revolved twice as fast as the first pair. The effect was that between the two sets, the roving was drawn out to double its former length, and, of course, half its tenuity. The rollers thus supplanted the drawing by hand. By this mode of drawing the cotton, the fibres are straightened and made parallel; and the improvements that have since been made in the same direction are to increase the drawings and doublings, or the placing of several slivers together to be drawn down into one. In 1784, Crompton combined these two inventions into a third, called the mule-spinner. The machine of Arkwright was called the water-frame, because it was first driven by water power. The defect was, that it spun thread for warps only. It could not spin fine threads, because these could not bear the strain of the bobbins. This the mule remedied. Instead of the spindles being stationary, and the rovings movable, the former were placed upon a movable frame which runs out fifty-six inches, to stretch and twist the thread, and runs in again for it to wind upon the spindles. The thread is thus treated more gently. The effect of this machine is best understood by the fact that a "hank" of thread measures 840 yards, and it was before supposed impossible to spin 80 of these hanks from a pound of cotton. The new machine spun 350 hanks to the pound, thus forming a thread 167 miles in length! This mule was improved to carry 130 spindles; and when water power was applied, in 1790, it carried 400 spindles. These mules, at the present day, carry 3,000 spindles, and are now self-acting.

The process of carding had also in this period undergone great improvements. The first improvement made in the old hand cards was to make one of them a fixture, and of a larger size than the other. The workman could thus work more cotton in the same time. He then proceeded to suspend the movable card by a pulley, with a weight to balance it. The next advance was to make the movable card a cylinder covered with cards, and turned by a handle, in a concave frame, lined also with cards, which was simply the fixed card curved to adapt it to the cylindrical form of the other. The lower part was let down in order to remove the cotton, by means of a stick with needles in it like a comb. The next improvement was in 1772, to attach an endless revolving cloth, called a feeder, on which the cotton was spread, and by it conveyed to the cylinder. The next step was to take the carded wool off the cylinder by means of another cylinder revolving in an opposite direction, and called the doffer. This being entirely covered with cards, gave a continuous fleece of cotton, which was in 1773 removed from it by means of a steel blade like a saw, working by short strokes. This broad fleece then passed through a funnel, by which it was contracted into a ribbon; it then proceeded through two rollers, that compressed it and let it fall into a deep can. The carding machine by these means approached perfection, but there was necessary to it the marvellous American invention of the card-making machine, which made the cards so perfectly and so cheaply as to make the cylinder carding possible. The concave frame in which the original cylinder revolved, was soon replaced by smaller cylinders covered with cards and revolving in a direction contrary to the main cylinder. Between the action of these, the cotton was more perfectly combed out.

The carding and spinning of yarn thus had become developed in a manner to meet the wishes of the weavers, but now genius was directed to the loom, and in 1785 the power loom was invented by the Rev. Dr. Cartwright. This was improved upon, until in 1803 a new loom was patented by Mr. Horrocks. These looms but slowly supplanted hand looms, notwithstanding their great superiority. The great obstacle to the success of the power loom was that it was necessary to stop it frequently to dress the warp as it came from the beam. The dressing is a size of flour and water, now used cold; the object of it is to make the thread smooth, like cat-gut. The inconvenience of the frequent dressing was remedied in 1802, by the invention of the dressing machine. By this machine the thread is wound from the bobbins upon the weaving-beam, and in its passage it passes through the starch. It is then pressed between rollers, and passing over hot cylinders to dry it, it is brushed in its progress. When wound upon the beam it is ready for weaving. The power loom thenceforth grew rapidly in favor. Before the invention of the dressing machine, one man was required to each loom; afterward, a girl of fourteen tended two, and produced with them three and one-half times as much cloth as the best hand weaver. Improvements were made, until, in 1833, a weaver fifteen years old, aided by a girl of twelve, would weave eighteen pieces of nine-eighths shirting of the same quality of which, in 1803, it required a grown man to make two in a week.

While these improvements in machines were made, there were discovered processes of bleaching quite as important. This process previously required six to eight months to steep in lyes and bleach upon the grass. By chemical discoveries, a bleaching powder, composed of manganese, salt, sulphuric acid, and lime, is effective in bleaching the rough, gray, and dirty fabric that comes from the weaver, in a few hours. Every thing is done by machinery and chemical agents.

The printing of calico was introduced into England in the seventeenth century, but made little or no progress until its introduction into Lancashire in 1764, when it was taken up by a farmer, Robert Peel, grandfather of the late prime minister of England, Sir Robert Peel. When he began to print, he had the cloth ironed out by one of his family, and used a parsley leaf for a pattern. The method was to cut the pattern upon blocks of sycamore, like an ordinary wood engraving. On the back of the block was a handle. The color was contained in a vessel, over which was stretched a woollen cloth, in contact with the liquid. To this the surface of the block was applied, and it was then laid upon the white cloth ironed out, and struck with a mallet; the figure was thus impressed. The block was then applied in a fresh place; so that a piece of calico twenty-eight yards, required 448 applications of the block. To make more delicate figures, copper plates were employed, with the press used for copper-plate printing. The copper-plate method was quite as slow as the block method. In 1785, cylinder printing was invented. A polished copper cylinder, three feet in length and four inches in diameter, is engraved with the figure on its whole surface. It is then placed in the press, and as it revolves, the lower part passes through the coloring matter, which is scraped from the surface as it rises by a steel blade nicely adjusted lengthwise. This blade is called the "doctor." The cloth passes between this roller and a large cylinder, and receives the impression by a continuous motion. Thus, two or three minutes now sufficed to do what required before 448 applications. Almost any number of these cylinders may be used at the same time in the same press, and with different colors. Thus a five cylinder press will do what would have required 2,240 applications by the block; in other words, a man and a boy could now do what before would have required 200 men and boys.

An American invention here made an important change in the printing. Mr. Jacob Perkins, of Massachusetts, invented the process of transferring an engraving from a very small steel cylinder to the copper. Before this, the whole of the copper cylinder required to be engraved, at great expense, and when done would print about 1,500 pieces of cloth before it was worn out. By the new mode, a steel cylinder three inches long and one in diameter, is prepared by being softened that it may be easily cut. The pattern to be engraved is so arranged and made to agree with the circumference of the copper cylinder, as to join and appear continuous when repeated. When this is cut upon the steel it is hardened, and then, by great pressure against another soft cylinder, the figure is made on it in relief, or raised upon its surface. This being hardened, transfers by pressure the design upon the whole of the copper cylinder. The engraving is thus multiplied fifty-four times, and may be renewed at short notice when the cylinder is worn. This was a most important step in advance. When many colors are required in the same pattern, portions of it are engraved upon separate dies, and the number of colors may be multiplied by adding cylinders.

We have thus sketched the state of affairs down to about the period of the introduction of the manufacture into the United States, which was about the period of the formation of the government. The imports of the raw material into Great Britain at that time, will show the rapidity with which the trade developed itself.

COTTON IMPORTED INTO GREAT BRITAIN.

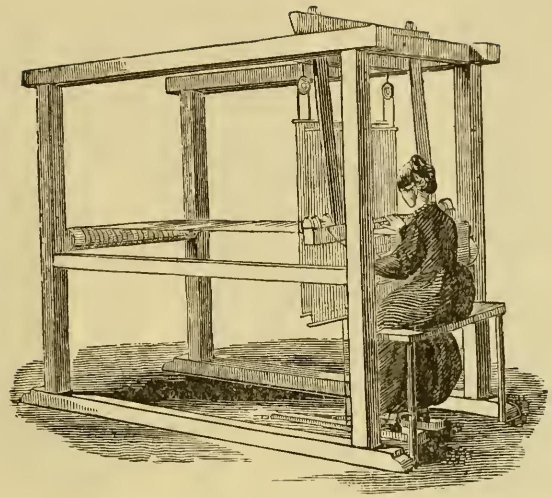
| | | | |
|---|---|---|---|
| 1775 | 4,765,589 lbs. | 1786 | 19,900,000 lbs. |
| 1781 | 5,198,777 " | 1789 | 32,576,023 " |

The cotton was derived as follows in 1786: British West Indies, 5,800,000 lbs.; French and Spanish do., 5,500,000 lbs.; Dutch do., 1,600,000 lbs.; Portuguese do., 2,000,000 lbs.; Turkey, 5,000,000 lbs. The United States contributed nothing. They did not then grow cotton.

The American invention of the cotton gin was more important than all the inventions we have described, for the reason that without it, and the American supply of cotton made possible by it, all the ingenuity of the English would have failed for want of material to work on. The sources of supply above mentioned have not increased in capacity. England has derived some cotton from India, but not so much in the raw state as she sends thither in goods, and the United States alone keep her mills in motion. While they have done this they have also developed the manufacture in a marvellous manner. We will here enumerate the dates of the above described inventions, in order to show that it was in the midst of the excitement they produced, that the manufacture was transported to America.

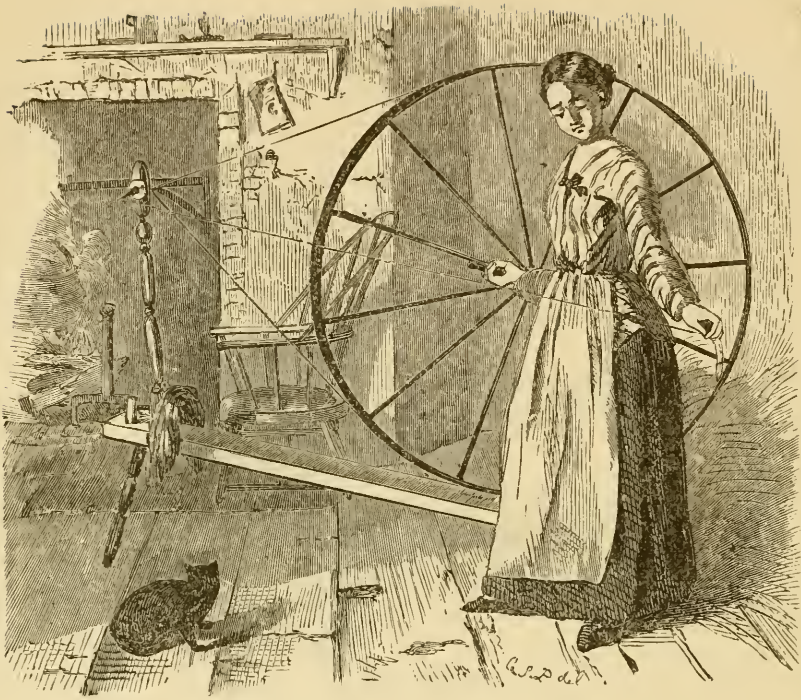
| | |
|---|---|
| Hargreaves' jenny | 1767 |
| Arkwright's rollers | 1769 |
| Crompton's mule | 1784 |
| Feeding for carder | 1772 |
| Doffer " " | 1773 |
| Cartwright's loom | 1785 |
| Water power used | 1790 |
| Cylinder printing | 1785 |
| Dressing machine | 1802 |

It was at the period so prolific in inventions, and when the use of cotton had so increased in England, that the manufacture was commenced in the United States. The first mill was at Beverly, Mass. It had a capital of £90,000, and was organized in 1787, for the manufacture of corduroys and

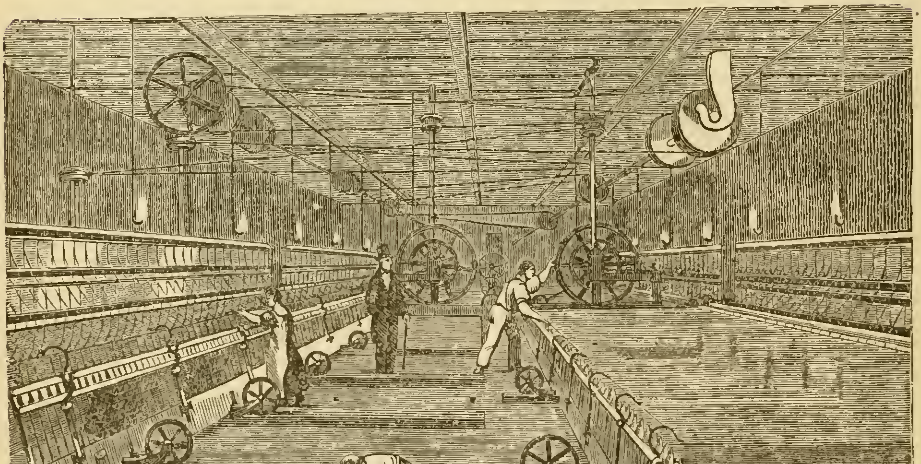


HAND LOOM.

POWER LOOM. ONE GIRL ATTENDS FOUR.



SPINNING BY HAND WITH A SINGLE SPINDLE.



THE MULE SPINNER IS GENERALLY DRAWN OUT AUTOMATICALLY BY STEAM OR WATER POWER.

bed ticks. The capital was swallowed up in fifteen years. The machines were very rude, inasmuch as the new inventions in England were then unknown here.

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## CHAPTER II.

### MANUFACTURE IN AMERICA—SPINNING—PROGRESS.

Samuel Slater was an apprentice to Jedidiah Strutt, the partner of. Arkwright. He served his time, and when of age departed for America, where he arrived in 1789. In the following year, he entered into partnership with Almey and Brown to start a factory at Pawtucket. Here, then, were put up, in the best manner, the whole series of machines patented and used by Arkwright for spinning cotton. There had been previous attempts at the spinning of cotton by water power, and some rude machines were in existence for spinning the rolls prepared by hand, in private families; but the machines that had been invented in England for the purpose were entirely unknown here until put up by Slater. Those machines were so perfect that, although put up in 1790, they continued to be used forty years, up to 1830, when they formed part of an establishment of two thousand spindles, which long existed in Pawtucket under the name of the "old mill." Slater's business was prosperous, and he amassed a large fortune. He died in 1834. His son and heirs still carry on the business. It is to be remarked that his business was confined to the spinning of cotton. The business, of course, spread as soon as it was found to be profitable; but, up to the war of 1812, the New England interests were commercial, and when the war broke out there was an immense rise in the value of goods, which gave to all existing spinning interests a great advantage. Cotton cloth sold at forty cents per yard; and Slater held almost a monopoly of the supply of yarn to make it. Mr. Slater had, in 1807, in connection with his brother John, who brought over important knowledge of the recent improvements in machinery, erected a mill at Slatersville, near Smithfield, R. I. Mr. Slater established a Sunday school for his operatives, and this is supposed to have been the first in New England.

It will be observed that Mr. J. Slater got his mill into operation at the same period that the federal government was organized under the new constitution, a most auspicious event. The manufacture did not fail to attract the attention of the new government, and Alexander Hamilton, secretary of the treasury, in his famous report of 1791, remarks:—

"The manufacture of cotton goods not long since established at Beverly, in Massachusetts, and at Providence, Rhode Island, seems to have overcome the first obstacles to success; producing corduroys, velverets, fustians, jeans, and other similar articles, of a quality which will bear a comparison with the like articles brought from Manchester. The one at Providence has the merit of being the first in introducing into the United States the celebrated cotton mill, which not only furnishes material for the factory itself, but for the supply of private families for household manufacture.

"Other manufactories of the same material, as regular businesses, have also been begun in the state of Connecticut, but all upon a smaller scale than those mentioned. Some essays are also making in the printing and staining of cotton goods. There are several small establishments of this kind already on foot."

The same report proposes, as an aid to the factories, to remove the duty of three cents per pound on the import of raw cotton, and to extend the duty of seven and a half per cent. to all cotton goods. It also remarks that cotton has not the same pretension as hemp to protection, as it is not a production of the country, and affords less assurance of an adequate supply. These few facts afford an idea of the notions then entertained of that cotton which has since overshadowed all other interests.

The old mill of Samuel Slater, Esq., the first building erected in America for the manufacture of cotton yarns, is a venerable wood-built structure, two stories in height, bearing numerous evidences of its antiquity, having been erected in 1793. Two spinning frames, the first in the mill, are still there, and are decided curiosities in their way. It is almost incredible to believe that this old building, time-worn and weather-browned, was the first to spread its sheltering roof over the young pupil of Arkwright, and that those dwarf frames, rusty and mildewed with inactivity, are the pioneer machines of that immense branch of our national industry—the manufacture of cotton goods. It may be remarked that down to 1828 the exportation of machines of all kinds, and also wool, was strictly prohibited in England, for fear other nations should benefit by English mechanical genius, of which they supposed they had a monopoly; when, however, they found that the balance of genius was on this side of the pond, they liberally removed the prohibition. Mr. Slater, the father of American cotton manufactures, was so closely watched at the English custom-house, that he could not smuggle over a drawing or pattern. He had, however, acquired a full knowledge of the Arkwright principle of spinning, and from recollection, and with his own hands, made three cards and twenty-two spindles, and put them in motion in the building of a clothier, by the water-wheel of an old fulling-mill. Eighty-eight years have since elapsed, and the business has in that period increased beyond all precedent in the history of manufactures. Our rivers and wild waterfalls, that then flowed and murmured in solitude, are now propelling thousands of mill-wheels, and millions of shuttles and spindles. In the business, hundreds of fortunes have been made, thousands of citizens earn a subsistence and find constant employment, while millions are clothed in different portions of the globe. A wonderful revolution has that old mill produced on the shores of the new world. When Gen. Jackson visited the mill, and complimented Slater on his having been the first: "Yes," he replied, "here I gave out the psalm, which is now sung by millions."

The machines for the spinning of cotton thence spread into several states, and continued to attract capital. The extent to which this was carried became evident in 1810, from the facts collected by the secretary of the treasury, Albert Gallatin, Esq. The manufactures of cotton and wool were then principally confined to families; and Mr. Gallatin thought it probable that about two-thirds of the clothing (including hosiery), of the house and table linen worn and used by the inhabitants of the United States, not residing in cities, was the product of family manufactures. The number of cotton mills returned to the secretary, which were erected at the close of the year 1809, was eighty-seven, sixty-two of which (forty-eight water and fourteen horse-mills) were in operation, and worked at that time 31,000 spindles. The other twenty-five, it was supposed, would be in operation in the course of the year 1810, and, with the former, would probably work eighty thousand spindles at the commencement of the year 1811. He estimated the amount of capital that would be employed in these mills at $4,800,000, the cotton used 3,600,000 lbs., the yarn spun at 2,880,000 lbs., valued at $3,240,000, the men employed 500, and the women and boys 3,500.

By the returns of the marshals of the census of 1810, the number of cotton factories was 168, with 90,000 spindles; but from most of the states no returns were made of the quantity of cotton used and the yarn spun. Massachusetts had 54, most of them, no doubt, small, having in the whole only 19,448 spindles, consuming but 838,348 pounds of cotton, and their produce valued at $931,916. Rhode Island had 26 factories, with 21,030 spindles, and Connecticut 14, with 11,883 spindles. These were for the supply of yarn to be used in hand looms exclusively.

In this position of affairs the war took place; but just on its eve Mr. Francis C. Lowell, of Boston, returned from Europe, where he had inspected the great improvements in machines for cotton manufacturing, and had formed the project of establishing the manufacture in this country. He associated with himself in the enterprise his brother-in-law, Patrick S. Jackson, and they set about it. The country was then at war with England, and there was no possibility of getting either models or machines thence, nor even drawings. The memory of Mr. Lowell was all that was to be depended upon for the structure of the machinery, the materials used in the construction, even the tools of the machine shop. The first object to be accomplished was to procure a power loom. To obtain one from England was, of course, impracticable; and although there were many patents for such machines in our Patent Office, not one had yet exhibited sufficient merit to be adopted into use. Under these circumstances but one resource remained—to invent one themselves—and this these earnest men at once set about.

Unacquainted as they were with machinery in practice, they dared, nevertheless, to attempt the solution of a problem that had baffled the most ingenious mechanicians. In England, the power loom had been invented by a clergyman, and why not here by a merchant? After numerous experiments and failures, they at last succeeded, in the autumn of 1812, in producing a model which they thought so well of as to be willing to make preparations for putting up a mill for the weaving of cotton cloth. It was now necessary to procure the assistance of a practical mechanic, to aid in the construction of the machinery, and the friends had the good fortune to secure the services of Mr. Paul Moody, afterward so well known as the head of the machine shop at Lowell. They found, as might naturally be expected, many defects in their model loom; but these were gradually remedied. The project hitherto had been exclusively for a weaving mill, to do by power what had before been done by hand looms. But it was ascertained on inquiry that it would be more economical to spin the twist than to buy it, and they put up a mill for about 1,700 spindles, which was completed late in 1813. It will probably strike the reader with some astonishment to be told that this mill, still in operation at Waltham, was probably the first one in the world that combined all the operations necessary for converting the raw cotton into finished cloth. Such, however, is the fact, as far as we are informed on the subject. The mills in this country—Slater's, for example, in Rhode Island—were spinning mills only; and in England, though the power loom had been introduced, it was used in separate establishments, by persons who bought, as the hand weavers had always done, their twist of the spinners. Great difficulty was at first experienced at Waltham, for the want of a proper preparation (sizing) of the warps. They procured from England a drawing of Horrocks' dressing machine, which, with some essential improvements, they adopted, producing the dresser now in use at Lowell and elsewhere. No method was, however, indicated in this drawing of winding the threads from the bobbins on to the beam; to supply this deficiency, the macnine called the warper was invented, and there was now no further difficulty in weaving by power looms. The "double speeder," answering to the fly frame for spinning roving, was then added. Mr. Moody then invented the machine called the filling throstle, for winding the thread for weft from the bobbin on to the quills for the shuttle. The manufacture, as far as machinery went, was now on a permanent basis. The difficulty that presented itself was in operatives. There was here no such pauper class as that from which the English mills were supplied, and the factories were to be recruited from respectable families. By the erection of boarding-houses, at the expense and under the control of the factory; putting at the head of them matrons of tried character, and allowing no boarders to be received except the female operatives of the mill; by stringent regulations for the government of these houses—by all these precautions, they gained the confidence of the rural population, who were no longer afraid to trust their daughters in a manufacturing town. A supply was thus obtained, of respectable girls; and these, from pride of character, as well as from principle, took great care to exclude all others. It was soon found that apprenticeship in a factory entailed no degradation of character, and was no impediment to a respectable connection in marriage. A factory girl was no longer condemned to pursue that vocation for life; she would retire, in her turn, to assume the higher and more appropriate responsibilities of her sex; and it soon came to be considered that a few years in a mill were an honorable mode of securing a dower. The business could thus be conducted without any permanent manufacturing population. The operatives no longer formed a separate caste, pursuing a sedentary employment, from parent to child, in the heated rooms of a factory, but were recruited in a circulating current from the healthy and virtuous population of the country. The success which these mills met with of course prompted their extension. In 1821, Mr. Ezra Worther, who had formerly been a partner with Mr. Moody, and who had applied to Mr. Jackson for employment, suggested that the Pawtucket canal, at Chelmsford, would afford a fine location for large manufacturing establishments, and that probably a privilege might be purchased of its proprietors. To Mr. Jackson's mind the hint suggested a much more stupendous project—nothing less than to possess himself of the whole power of the Merrimac river at that place. Aware of the necessity of secrecy of action, to secure this property at any reasonable price, he undertook it singlehanded. It was necessary to purchase not only the stock in the canal, but all the farms on both sides of the river, which controlled the water-power, or which might be necessary for the future extension of the business. Such was the beginning of Lowell, since so world-renowned. A new company, the Merrimac, was immediately established under the direction of Kirk Boott, Esq.

The establishment of the Lowell mills took place at a time when the occurrence of war had diverted the capital of New England from commerce, and it eagerly sought new modes of investment. These were presented in the promising prospects of the newly invented machine manufactures. The cotton growth of the south had become large before the war, and that event caused an immense accumulation of stock that sunk the price to the lowest point, and by so doing, offered an abundance of raw material at rates merely nominal compared with what the English manufacturers had been paying. This gave a great advantage to the new enterprise, and Congress aided it by the establishment of protective duties. The *minimum* cotton duty was invented for the purpose. The rate was nominally *ad valorem*, but the price was fixed at a *minimum*, on which the duty was cast—hence the duty was in effect specific. Thus, the abundant raw material, the low price of cotton, and the protection of the government, all combined to give breadth to the newly awakened manufacturing fever. The capital that crowded into it, soon, as a matter of course, overdid the business, and distress followed, which was sought to be relieved by a still higher tariff in 1824. That seemed, however, to add but fuel to the flame; and in 1828, still higher rates were demanded. We may compare these tariffs: cotton goods not dyed were to be valued at twenty-five cents per square yard, and pay twenty-five per cent. duty, or six and a quarter cents per yard; goods printed or dyed were to pay nine cents per square yard; fustians, moleskins, etc., were to pay twenty-five cents per square yard; woollens were charged twenty-five per cent. in 1816, thirty-three and a half per cent. in 1824, and forty-five per cent. in 1828. Under all these circumstances, the manufacture could not fail to grow rapidly, and of course to bring on distress as the result. In 1831, the tariff excitement had reached such a pitch that the most disastrous political results were anticipated. It was then that the committee of the convention collected information of the existing manufactures. They reported the table which we annex. The returns are for the eleven states where manufactures were well developed; some twenty to thirty other mills were also reported, but so imperfectly that the returns were rejected. The table is very valuable—as follows:—

STATEMENT OF THE NUMBER OF COTTON ESTABLISHMENTS IN THE ELEVEN FOLLOWING STATES, AND THEIR PRODUCTS IN 1831.

| | Virginia. | Maryland. | Maine. | N. Hampshire. | Massachusetts. | Connecticut. | Rhode Island. | New York. | New Jersey. | Pennsylvania. | Delaware. | Total. | Machine shops. | Bleacheries. | Printeries. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital | $290,000 | 2,144,000 | 765,000 | 5,300,000 | 12,891,000 | 2,825,000 | 6,262,340 | 3,671,500 | 2,027,644 | 3,758,500 | 384,500 | 40,614,984 | 2,400,000 | 900,000 | 1,000,000 |
| Number of mills | 7 | 23 | 8 | 40 | 250 | 94 | 116 | 112 | 51 | 67 | 10 | 795 | .. | .. | .. |
| Number of spindles | 9,844 | 47,222 | 6,500 | 113,776 | 339,777 | 115,528 | 235,753 | 157,316 | 62,979 | 120,810 | 24,806 | 1,246,503 | .. | .. | .. |
| Number of looms | 91 | 1,002 | 164 | 3,530 | 8,981 | 2,609 | 5,773 | 3,653 | 815 | 6,301 | 235 | 33,506 | .. | .. | . |
| Pounds of yarn sold | 869,000 | 1,104,000 | .. | | 807,366 | 487,900 | .. | 1,867,790 | 3,212,184 | 2,192,865 | .. | 10,642,000 | .. | .. | . |
| Yards of cloth | 675,000 | 7,649,000 | 1,75[illegible],000 | 29,060,500 | 79,231,000 | 20,055,500 | 37,121,681 | 21,010,920 | 5,133,776 | 21,332,467 | 5,203,746 | 230,461,990 | .. | .. | .. |
| Pounds of cloth | 168,000 | 2,224,000 | 525,000 | 7,255,060 | 21,301,062 | 5,612,000 | 9,271,481 | 5,297,713 | 1,877,418 | 4,207,192 | 1,201,500 | 59,604,926 | . | .. | .. |
| Males employed | 143 | 824 | 54 | 875 | 2,665 | 1,399 | 1,731 | 1,374 | 2,151 | 6,545 | 697 | 18,589 | 3,200 | 612 | 950 |
| " Wages per week | $2 73 | 3 87 | 5 50 | 6 25 | 7 00 | 4 50 | 5 25 | 6 00 | 6 00 | 6 00 | 5 00 | .. | 7 50 | 6 00 | 7 00 |
| Females employed | 275 | 1,793 | 205 | 4,090 | 10,678 | 2,477 | 3,297 | 3,652 | 3,070 | 8,351 | 676 | 38,927 | .. | 126 | 125 |
| " Wages per week | $1 58 | 1 91 | 2 33 | 2 60 | 2 25 | 2 20 | 2 20 | 1 90 | 1 90 | 2 00 | 2 00 | .. | .. | 2 88 | 2 52 |
| Children under 12 y'rs | .. | .. | .. | 60 | .. | 439 | 3,472 | 484 | 217 | .. | .. | 4,691 | .. | .. | 432 |
| " Wages per week | .. | .. | .. | 2 00 | .. | 1 50 | 1 50 | 1 40 | 1 40 | | .. | | .. | .. | 1 82 |
| Pounds of cotton used | .. | 3,008,000 | 588,500 | 7,845,000 | 24,871,981 | 6,777,209 | 10,414,578 | 7,961,670 | 5,832,204 | 7,111,174 | 1,435,000 | 77,757,816 | . | . | .. |
| Pounds of starch | 8,700 | .. | 15,000 | 164,000 | 907,480 | 187,135 | 324,908 | 34,030 | .. | .. | .. | 1,641,253 | .. | 429,625 | .. |
| Bbls. of flour for sizing | 852 | 874 | 70 | 1,900 | 2,351 | 516 | 1,334 | 2,409 | 975 | 5,714 | 750 | 17,245 | .. | .. | 1,300 |
| Cords of wood | 50 | 6,148 | 400 | 7,300 | 9,476 | 7,193 | 1,440 | 7,038 | 671 | 5,000 | 750 | 46,519 | .. | .. | 30,000 |
| Tons of coal | 200 | 65 | .. | 1,500 | 2,621 | 247 | 1,410 | 488 | 1,007 | 15,314 | 768 | 24,420 | .. | 19,250 | 2,250 |
| Bushels of charcoal | 1,000 | 400 | .. | .. | 4,635 | 3,350 | .. | .. | 820 | .. | .. | 9,205 | .. | .. | |
| Gallons of oil | . | 12,875 | 2,700 | 40,000 | 68,428 | 25,217 | 61,457 | 35,923 | 13,318 | 29,300 | 6 000 | 300,338 | | .. | 2 800 |
| Value of other articles | 2,070 | 31,045 | 3,200 | 103,000 | 180,677 | 30,065 | 77,433 | 60,335 | 18,208 | 74,[illegible]40 | 12,000 | 599,223 | 1,960,212 | 276,265 | 930,585 |
| Total dependants | 270 | 4,208 | 389 | 8,000 | 25,211 | 7,266 | 17,567 | 12,951 | 12,750 | 25,000 | 2,500 | 117,626 | 9,[illegible]00 | 1,403 | 2,860 |

REMARKS.—Delaware includes $162,000, and Pennsylvania $500,000 for the capital employing the hand looms. The cotton consumed, 77,757,816 lbs., is 214,882 bales of the average weight of 361 86-100.

Such had been the immense growth of the manufacture in ten years from the time the Lowell mills were started, when but little machine cloth was made; but in 1831, there was made, it appears, 230,461,990 yards, or nearly twenty yards per head for all the people. It is obvious that this large and sudden production of cloth could have found vent only by supplanting the work of families and hand looms, and of course by pressing hard upon the spinners of yarn. The New England mills were mostly carried on as one concern, spinning and manufacturing together. This, however, was not the case with the mills in the middle or the new states. The mills there were mostly employed in spinning only, as were the first New England mills. The yarns were produced for sale to hand looms. The census of 1840 gave the number of mills in the whole country at 1,240, and the number of spindles at 2,284,631, consuming 132,835,856 lbs. of cotton; and the manufacture had continued to spread into the southern and western states. That was still hand weaving, which yet obtained in many parts of the older states of the Union. Thus, while in Pennsylvania the capital invested amounted to about one-seventh of that of Massachusetts, the quantity of cotton consumed was one-fifth; the value of the raw material, not quite one-fourth; number of operatives (male and female), one-fourth; value of products, rather more than one-fourth; the number of pounds of yarn spun and sold as yarn was above thirty times greater in Pennsylvania than in Massachusetts. This, to a certain extent, gave a key to the differences in the modes of manufacture in the two states. There could be no doubt, however, that domestic weaving was gradually giving way, and those manufacturers, especially in Pennsylvania, who formerly did a prosperous business as spinners only, now found that the eastern states supplied the piece goods at a rate so little above the cost of the yarn, that it was not worth the while of the farmer to continue this primitive custom of weaving his own cloth. Thus the domestic loom had begun to follow the spinning wheel of the early settlers, and those manufacturers who, a few years since spun yarn only, gradually introduced the power loom as the only means of sustaining their position in the market. This was illustrated by the Eagle Cotton Mill, Pittsburg, Pennsylvania. Formerly, the proprietors spun yarn only, and did a successful trade; but, by a return which they made, it appeared that in six establishments under their direction they had introduced already 540 looms to the 26,000 spindles, and were manufacturing sheeting at the rate of 6,000,000 yards per annum, together with twilled cotton bags, batting, and yarns, and this in order to make the latter pay, by consuming the surplus yarns themselves. In the Penn Cotton Mill, Pittsburg, the more modern system has become the rule of the establishment, and with 7,000 spindles and 207 looms, 2,730,000 yards of shirtings were produced annually, besides 240,000 lbs. weight of colored yarns for cotton warps and cotton rope. At two establishments in Richmond, Virginia, the consumption of the yarn in the manufacture of piece goods was the rule. Georgia, Tennessee, and North Carolina were quoted as those in which the greater progress had been made, while Virginia, South Carolina, and Alabama were the next. In Tennessee, spinning would appear to be the rule and manufacturing the exception; in Georgia and North Carolina, equal attention is paid to both; while in Virginia, South Carolina, and Alabama, the manufacture of the piece goods was decidedly more extensively carried on than spinning; but slave labor was largely used, with free whites as overseers and instructors. The males were heads of departments, machinists, dressers, etc., and the females were spinners and weavers. The latter were chiefly adults, though children from twelve to fifteen were employed. The average hours of work here were twelve, but varied a little with the season, very full time being the rule. The James River Mill produced a large weight of work for the extent of its machinery. The goods manufactured were coarse cottons, and averaged about two and one-half yards to the pound, shirtings, twenty-eight inches wide (osnaburgs), summer pantaloons for slaves, and bagging for export to the Brazils for sugar bags, running about three yards to the pound. Bagging of a lighter character for grain, and thirty-six inch osnaburgs, two yards to the pound, were also produced. The Manchester Company manufactured sheetings, shirtings, and yarns, and employed about 325 operatives; the children being of the same average age as at the James

River Mill. Mr. Whitehead, of Virginia, in 1853, perfected a patent speeder. Its advantages are a greater speed, a more even roving, and a bobbin of any desirable size, which never becomes spongy in the winding. In Maryland, however, there were twenty-four establishments in 1850, chiefly engaged in the manufacture of piece goods, such as drillings, sheetings, ducks, osnaburgs, and bagging. The yarns produced for domestic purposes bore but a small proportion to those manufactured into cloth, and these were chiefly sold within the state for the home weaving of mixed fabrics of wool and cotton, forming coarse linseys. If the illustrations given show the early progress and position of this manufacture in the United States, so far as daily-recurring improvements and ever-increasing wants have permitted it to remain in its original form, the manufacturing towns of Lowell, Manchester, and Lawrence, strikingly demonstrate the results of the energy and enterprise of the manufacturers of New England. At Lowell, Mass., the cotton manufacture was developed in a form which has been a theme for many writers on the economy and social bearing of the factory system; and the plans so successfully put into operation here and carried on since 1822 have led to the erection of large establishments, with their attendant boarding-houses, at Manchester, and Nashua, N. H., and at Lawrence, and Holyoke, Mass. The falls of the Pawtucket on the Merrimac river and the Pawtucket canal, which had previously been used only for the purpose of navigation and connecting the river above and below the falls by means of locks, presented to the original projectors of Lowell a site for the solution of an important problem, not only in American industry, but to a great extent in that of Europe itself. This was the combination of great natural advantages with a large and well-directed capital, resulting in extensive and systematic operations for the realization of a legitimate profit, while the social position of the operative classes was sedulously cared for, and their moral and intellectual elevation promoted and secured.

The census of 1870 gave figures that show the extent of the manufacture as it existed at that date, in all the states. Those figures are as follows:—

COTTON MANUFACTURES OF THE UNITED STATES PER CENSUS OF 1870.

| States. | No of Establishments. | Capital. | Cost of Raw Material. | Male Hands. | Female Hands. | Cost of Labor. | Value of Products. |
|---|---|---|---|---|---|---|---|
| Maine | 23 | $9,839,685 | $6.746.780 | 2,606 | 6.833 | $2,565,197 | $11,842,781 |
| New Hampshire | 36 | 13,332,710 | 12,318,867 | 3,752 | 8,790 | 3,989,853 | 16,999,672 |
| Vermont | 8 | 670,000 | 292.269 | 125 | 326 | 125.000 | 546.510 |
| Massachusetts | 194 | 44,832,375 | 37.485,686 | 13.713 | 29,883 | 13,612,925 | 59,679,123 |
| Rhode Island | 142 | 18,885.300 | 13,325,938 | 5.697 | 11,213 | 5 210,333 | 22,139,203 |
| Connecticut | 111 | 12,710,700 | 8,818,661 | 4.443 | 7.643 | 3.246,783 | 14,026.344 |
| New York | 81 | 8,511.336 | 6,990,626 | 2,748 | 6,604 | 2.626.131 | 11,177,251 |
| Pennsylvania | 143 | 12,575,821 | 10,759.473 | 3,881 | 8.882 | 3,610 534 | 17.565.928 |
| New Jersey | 29 | 2,671.500 | 2,007,408 | 798 | 2,629 | 1,018,751 | 4,078.768 |
| Delaware | 6 | 1,165.000 | 704,733 | 225 | 501 | 190,069 | 1.060,898 |
| Maryland | 22 | 2,734,250 | 3,409,426 | 688 | 2,172 | 671,933 | 4.852,808 |
| District of Columbia | .... | .......... | .......... | ...... | ...... | .......... | .......... |
| Ohio | 7 | 555,700 | 493,704 | 216 | 246 | 113.520 | 679,835 |
| Indiana | 4 | 551,500 | 542,875 | 119 | 385 | 113.200 | 778,047 |
| Illinois | 5 | 151,000 | 177,525 | 26 | 72 | 25.5 0 | 279.000 |
| Utah | 3 | 42,000 | 7,051 | 10 | 6 | 6,300 | 16,803 |
| Missouri | 3 | 489,200 | 481,745 | 107 | 254 | 120,300 | 798,050 |
| Kentucky | 5 | 405,000 | 375,048 | 77 | 192 | 57,951 | 498,960 |
| Virginia | 11 | 1,128,000 | 937.820 | 921 | 820 | 229.750 | 1,135,800 |
| North Carolina | 33 | 1,030,900 | 963,809 | 232 | 1,119 | 182,951 | 1,345.052 |
| South Carolina | 12 | 1,337,000 | 761.469 | 289 | 834 | 257.680 | 1.529.937 |
| Georgia | 34 | 3,433,265 | 2,504,758 | 1,147 | 1,699 | 611,868 | 3,618,973 |
| Florida | .... | .......... | .......... | ...... | ...... | .......... | .......... |
| Alabama | 13 | 931,000 | 1,064.965 | 301 | 729 | 216,679 | 1,088,768 |
| Louisiana | 4 | 592,000 | 161,485 | 123 | 123 | 60.600 | 251,550 |
| Texas | 4 | 496.000 | 216,519 | 184 | 107 | 68,211 | 314.598 |
| Mississippi | 5 | 751,500 | 123,568 | 78 | 187 | 61,833 | 234,445 |
| Arkansas | 2 | 13.000 | 13,780 | 8 | 9 | 4,100 | 22,562 |
| Tennessee | 28 | 970.650 | 595,789 | 252 | 638 | 175,156 | 941.542 |
| Iowa | 1 | 1,500 | 4,950 | 3 | 3 | 275 | 7,000 |
| Total | 969 | $140,907 892 | $111,976,716 | 42,957 | 92,866 | $39,103,383 | $177,903,687 |
| Total in 1860 | 1,091 | 98,585,269 | 57,285,534 | 46,859 | 75,169 | 23,940,168 | 115,681,774 |
| Increase or Decrease | —122 | +$42,322,623 | +$54,691,182 | —3,902 | +17,637 | +$15,163,215 | +$62,221,913 |

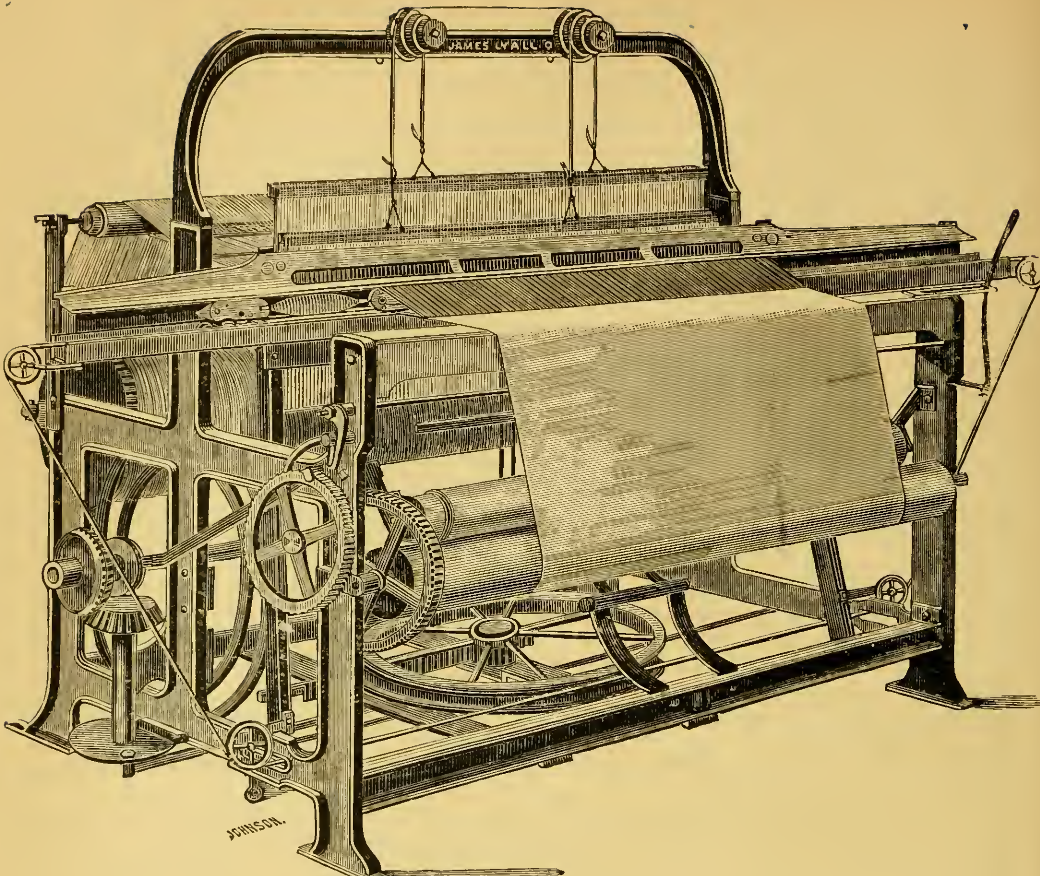



Fig. 1.—LYALL'S PATENT POSITIVE MOTION POWER LOOM—COMPLETE.

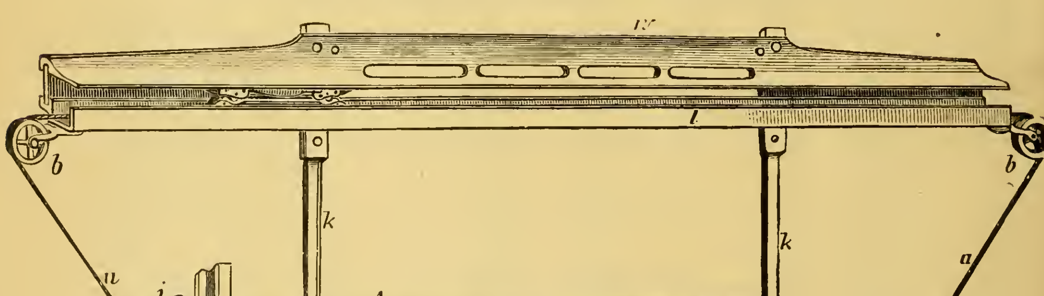
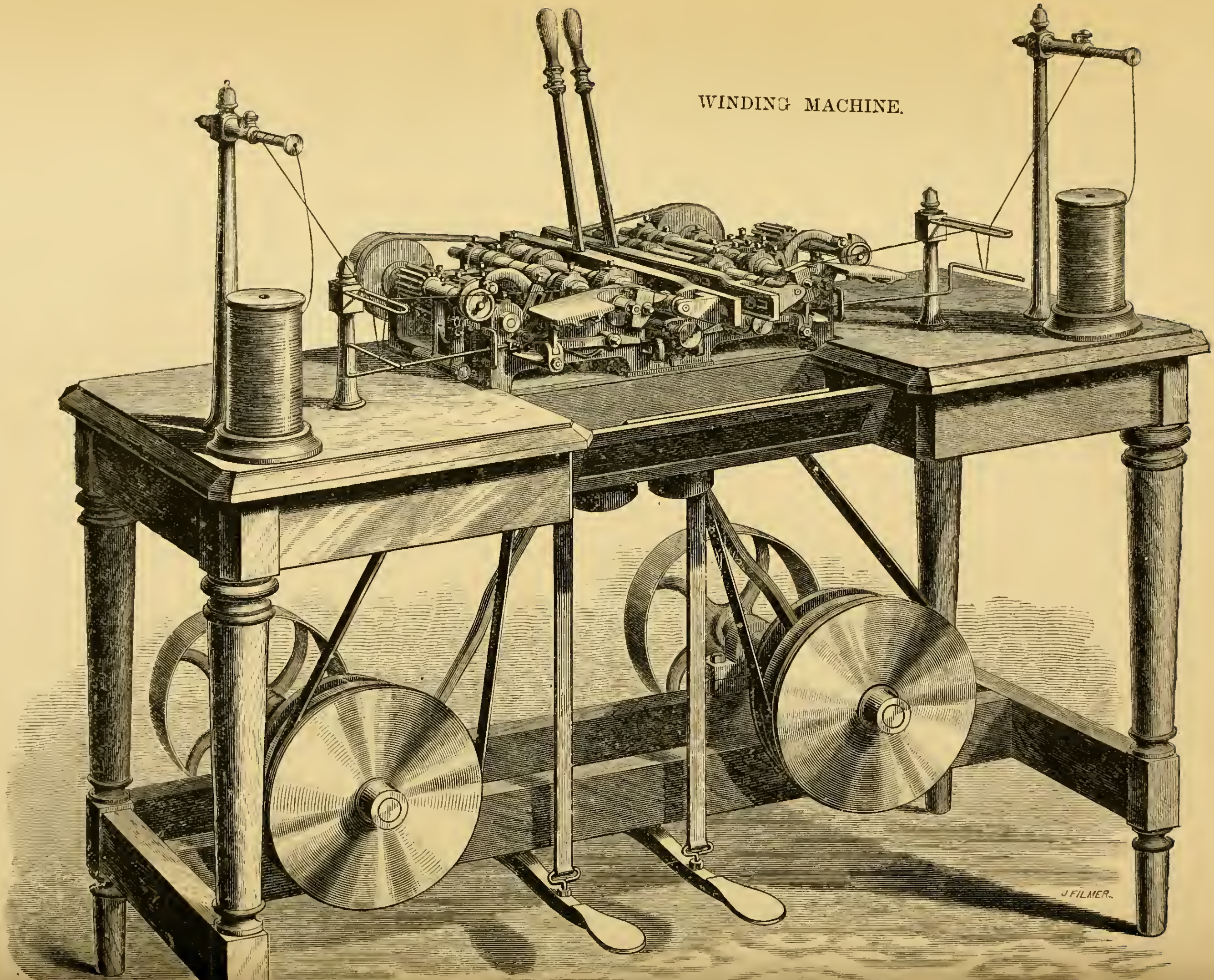



Fig. 4.—SHOWING MOTION OF SHUTTLE.


LYALL'S GREAT TEXTILE EXHIBIT AT THE CENTENNIAL.




WINDING MACHINE.

WILLIMANTIC LINEN CO.'S EXHIBIT

## CHAPTER III.

### INVENTIONS—MODE OF MANUFACTURE—PRINTING—AGGREGATE.

The past decade (1870–1880) has been remarkable for the improvements and new processes introduced into all departments of the cotton manufacture. Among these are, in spinning, the Clement and Goggin attachments, both of which combine the principle of the gin with that of the spinning mule, and use the seed cotton instead of the ginned cotton.

It does not seem to be fully settled yet that these attachments are of universal value, even in the cotton states, but, as they are coming into somewhat extensive use there, it may be well to state, in the words of one of the owners of the Clement attachment, Mr. F. E. Whitfield, of Corinth, Miss., what the process is, what it costs, and what is claimed for it:

"To convert an old into a new-process cotton mill, little else is necessary than to get a cleanser of seed cotton, capacity from 6,000 to 10,000 pounds seed cotton per day, cost from $75 to $100, and to substitute an attachment, costing about $175, for the lickerin and feed rollers on each card; this is easily and quickly done, and no other piece of machinery is changed. Now let us see what are the advantages, savings, etc , of the Clement attachment. The seed cotton is first passed through the cleanser, which removes all dirt, dust, and most of the motes, trash, etc.; it is then carried by a revolving apron directly into the breast of the attachment at the rate of from $\frac{3}{4}$ to 2 pounds of seed cotton per minute, where the lint is all removed from the seed; the filaments, not being permitted to fly or leave the machinery, are passed through the moters of the attachment, where all trash, motes, and other extraneous matter not removed by the cleanser or saws, are combed out, and the filaments delivered to the card, passing through which they fall either into a revolving can (if only one card is used), or (where three or more are used) into the ordinary railway trough, whence, passing through the usual machinery, it is converted into yarns of any number.

"First.—It is claimed and practically demonstrated by every new process mill, that the attachment dispenses with nearly one-half the buildings, motive power, machinery, and operatives, hitherto necessary to convert any given amount of seed cotton into yarn in any specific time.

"Second.—That the card is made to do four times as much work, using seed cotton and the same amount of motive power, as it did by the old process, using lint cotton after it had passed through six or eight different machines.

"Third.—That it removes all lint from the seed (estimated by oil men as 6 or 8 per cent. of the cotton), saves the waste in the lint room of the gin and picker room of the factory; also saves some waste in the other factory rooms, on account of the superior strength of the sliver, rove, and thread.

"Fourth.—That it produces stronger sliver, rove, and thread, the latter of any numbers, more sheeney, and 50 per cent. stronger than yarns made of bladed cotton, thereby enabling operatives to attend more machinery, and each machine to do more work, especially in the spinning and weaving room.

"Fifth.—That it saves the ginning, baling bagging, and ties, amounting to $5.50 per bale."

It may be added that the cleansing of the seed from the lint not only saves a considerable amount of excellent cotton, but greatly facilitates the work of the cotton seed oil mills, and enables them to produce a better quality of oil cake, and at a lower rate. Other improvements have been made in the spinning frames, by which greater perfection in the threads is secured, as well as a greatly increased production.

Machines for combing the cotton, in order to obtain fibers of uniform length, have been introduced, especially in the cotton thread manufacture, and the cotton thread made in this country is now accounted superior to that imported.

The drawing frames have been greatly improved, preventing waste, and producing finer and better yarns, stronger, and in much greater quantity from the machines.

The substitution of the "slasher," an English invention, for the "dresser," in the preparation of the warp for sizing or starching it before weaving it, is pronounced by Mr. Edward Atkinson the most marked single change in cotton machinery which has occurred within his experience. "The dresser was operated in a room at a constant heat of 100° to 110°, and in an atmosphere saturated with the steam given off by sour starch; one machine, attended by one man, was needed for every forty or fifty looms. The slasher is operated in a cool, well-ventilated room, and one machine, attended by one man with a boy to aid him, will serve 250 to 350 looms, the number varying with the description of the fabric."

We have already alluded to the double adjustable ring, in connection with the Sawyer and New Rabbeth spindles, and the Draper filling spinner, as producing a revolution in doing away with the mule spinners, which so long held the ground in cotton spinning.

The improvements in looms both for plain and figured weaving, and for all widths, have been equally remarkable. There are very many of these, all possessing strong claims, but perhaps for some purposes, especially on the narrower goods, the Earnshaw needle loom, perfected by Greenleaf, has as great merit as any, and advantages over most. For the widest goods there are several excellent looms, among which Lyall's patent positive motion power loom is perhaps the best.

The bleaching, dyeing, and calico and delaine printing processes have also made great advance during the past ten or fifteen years; so great that in all these departments American goods compete favorably with any in the world, and our printed goods, as well as our bleached and unbleached cloths are sold in Manchester, and preferred to the English in China, India, and Brazil.

But it is not alone in the manufacture of the cotton fiber that the cotton plant furnishes material for the world's industry. The cotton seed, long regarded as a waste product, or at most indifferently rotted for a manure, is now pressed for its oil, which is superior in quality to linseed oil, and for many purposes to olive oil, and for which the demand far exceeds the supply. The oil cake, left after the expression of the oil, is also in great demand for the feeding of cattle, milch cows, and sheep, while the hulls, which can be separated before pressing, form an admirable paper stock or pulp, and are likewise in request for the packing of the pistons of steam engines. The stalks of the cotton are also of great value for paper stock.

Mr. Edward Atkinson grows eloquent over the uses of the cotton seed. In a communication to the *N. Y. Herald*, in August, 1880, he says, "The value of the seed is yet an unknown quantity. It may seem almost the work of a visionary to compute it. If we make 6,000,000 bales of cotton fiber in a year (we made at least 6,500,000 in 1880), the weight of cotton seed that will remain after enough has been set aside for the next year's planting will be 3,000,000 tons. If the whole of this seed be treated as a small portion is now treated, this seed will give the following results: about 90,000,000 gallons of oil, about 1,300,000 tons of oil cake or meal, about 1,500,000 tons of hulls, from which there is every reason to suppose, from experiments here and actual use elsewhere, that 750,000 tons of paper may be made. Otherwise, these hulls ground into meal with the oil cake will leave as food for stock 2,800,000 tons in all. Each ton of this ground meal will carry at least five sheep six months; the rest of the year they would have ample food from the annual grasses that are the pest of the cotton planter, or from corn fodder, cowpeas, or other refuse or alternate crops. The waste of the cotton gin and oil press, with other waste of the cotton farm, will therefore suffice for not less than 14,000,000 to 20,000,000 sheep, probably for double that number. These sheep folded upon the cotton field would so fertilize the soil as to double the crop of cotton on any given acre of uplands; the manure of animals fed on cotton seed meal being richer than that from any other known variety of food."

While the manufacture has thus spread over the face of the Union, the pioneer mills, or those which are erected in new localities, are generally employed in the spinning of yarn of coarse sorts; the old mills gradually spinning finer yarn, and attaching weaving and printing to their operations. In the whole period, however, of the past seventy years, continued improvements have been made in machines and in power. Those mills that came into operation with fresh capital and the newest machines, had always advantages over those which still worked the old machines. The introduction of steam as a motor also favored the introduction of mills into localities that were not provided with water, and many persons contended that steam was cheaper and better even where water power existed. The latter was improved in its turn by the introduction of turbine wheels, which are a steady and sufficient power. The streams of New England were by art made to contribute in a wonderful manner to the work of factories. The works at Holyoke, Mass., are a singular instance of genius and enterprise. In the machines themselves, the greatest improvements have been continually made, in this country, as well as abroad. The card-sticking machine, the steel die of Perkins, ring spindle of Jenks, the improved throstle of M'Cully, the tube-frame, the patent size of Mallerd, of Lowell, are among the most important of a crowd of inventions that have been made by American mechanics. The ring spindle of Mr. Jenks is very curious, and is producing important results. That gentleman was a pupil of Slater, and had an establishment for the manufacture of cotton machinery near Philadelphia, since 1810. On the starting of the Lowell mills, Mr. Moody invented a number of machines, viz., a loom, a filling frame, a double speeder, a governor, and also what is called the "dead spindle," in distinction to the "live spindle," which was the English invention. The dead spindle is mostly used in Lowell. Mr. Jenks' ring spindle, however, superseded both, as it was found to produce more and better yarn. The spindle of this improved frame has no fly, but has a small steel ring, called a traveler, about a quarter of an inch in diameter, with a slit for the insertion of the thread, which is wound by the ring traveling around the bobbin, being held in its horizontal plane, during its circuit, by an iron ring loosely embraced by its lower end and fastened upon the traversing rail, being sufficiently large to allow the head of the bobbin, as well as the traveler, to pass through without touching. This plan of spindle may be driven 8,000 revolutions per minute with perfect security when spinning coarse yarn, and when producing the finer numbers, 10,000 revolutions per minute is not an extraordinary speed for it to attain. Since 1870, and between that date and 1878, the double adjustable ring has been perfected, and is used in connection with the Sawyer and New Rabbeth spindle in all the new mills. This is a great advance on Jenks' original ring spindle in speed and perfection of yarn. The Draper filling spinner, invented in 1877, will at no distant day banish the mule completely from the field.

The manufacture, as at present conducted, is a most beautiful and complicated art. The raw material is divided into long staple, medium staple, and short staple. The staple means simply the length of the fiber, and it is characteristic of the origin of the article. The first or long staple is used for the warps, or the longitudinal threads of a cloth. These threads must be made of long staple; no other kind of cotton will spin into the fine numbers. The medium staple is used for the "weft," or cross threads of tissues. It is softer and silkier than the long staple, and fills up the fabric better. The long staple will not answer for this purpose. The quantity of cotton in the weft of cloth is from two to five times as much as that in the warp. The short staple is used for weft, but it is harsher and more like wool, and after washing or bleaching it makes the cloth meagre and thin. It is mixed with the medium staple in small proportions.

This last and almost, when alone, useless sort is that which comes from India, and the first or long staple is "sea island," raised on our southern coast. The medium staple, or that which is required for the great bulk of the manufactures, is alone found in the United States. It is that kind called "uplands," bowed Georgia, or New Orleans. The quality is a result of climate and soil.

The cotton having reached the mill, it is requisite that all of the same staple, but of different qualities, should be well mixed. to give as uniform a character as possible to the cloth. To attain this, the contents of a bale are spread out upon the floor, and upon it another is scattered, and so on until a huge pile, called a "bing," has been raised; a rake is then used to scrape down from the sides, thus mixing the whole as the cotton is required for the mill. This cotton is matted together and filled with dirt, sometimes by design to increase the weight fraudulently. It must, therefore, first of all be cleaned and the fibres loosened. For this purpose several machines are used. The favorite is a patent Willey, which is composed of two iron axles on a level with each other, each having four stout steel teeth. The teeth of both axles mesh together as they revolve, and also the fixed teeth attached to the inner casing of the box which contains them. These axles revolve 1,600 times in a minute, opening out the fibres and beating out the dirt from the cotton, which is blown through a tube by a revolving fan.

The second machine through which the cotton passes is the spreading machine, the object of which is to perfect the cleaning and loosening of the fibres. The cotton being carefully weighed and spread upon the feeding apron, passes in between a pair of rollers, where it meets the action of blunt knives revolving 1,700 times in a minute. The cotton coming from this machine is flattened into a filmy sheet of uniform thickness, and wound upon a roller. It is of the greatest importance that this feeding should be done evenly, as otherwise the "lap," as it winds upon the roller, will have thin and thick places, which will run through the subsequent manufacture.

The laps that come from the spreader wound on rollers, are now to go through the third process, that of carding. The machine for this purpose we have described. It receives the end of the lap from the roller of the spreader, and by its operation combs out and straightens the cotton into a delicate fleece, which the "doffer" delivers through a funnel, whence it is drawn compressed, elongated, and consolidated by a pair of rollers, that drop it into a tin can. To the observer it appears like a stream of cream running into the tin can. For very fine yarns, this process is repeated with finer cards. The first carding is then called breaking.

The fourth process for the cotton is the drawing. Hitherto the cotton has passed only through male hands; with the drawing it passes into those of females. The slivers, as they are dropped into the tin can from the carding machine, are exceedingly tender and loose, and the fibres are not yet arranged in the position proper for the manufacture of smooth yarn. This is to be perfected by the rollers of the drawing frame; some frames have three pairs of rollers and others four. The distance between the pairs of rollers is such that the longest fibre of cotton will not reach from the centre of one roller to that of another pair. This prevents breaking the fibres, but the rollers must not be too far apart, lest the cotton separate in unequal thicknesses. The "doubling," by which the end of a new sliver is laid on the middle of one running in, equalizes the sliver. The more it is doubled and drawn, the more perfect is the yarn, and this doubling is done sometimes 32,000 times.

The fifth operation is the roving, or first spinning process. The slivers under the action of the drawing frame become so thin and tender they will no longer hold together without a twist, and many machines are used for the purpose of imparting it, under the names of slubbin, fly frame, belt speeder, tube frame, and others. The operation is performed one or more times, according to the fineness of the yarn desired. The cans which receive the slivers from the drawing frames are placed upon revolving wheels, and the sliver passes from these to the fly frame. This came into use in 1817. In this frame the spindles are set vertically in one or two rows at equal distances apart, each passing through a bobbin, which is loosely attached to it, and which has a play equal to its length up and down on the spindle; at the top of the spindle is suspended a fly with two dependent legs, one solid, and the other hollow. The roving enters this by an eye immediately above the top of the spindle, and passing down the hollow leg attaches to the bobbin. The revolving spindle carries the fly with it, spinning and winding the roving at the same time. At this point enters a very nice calculation. The roller on which the roving is wound delivers it with the exact speed of the spindle, but as the size of the bobbin on the latter increases, it going at the same speed would take up the yarn faster than the roller would deliver it, and would strain it too much. This is avoided by a contrivance which varies the speed of the bobbin to meet the circumstances. The rovings having received this twist, are now to be spun into yarn, and this is done either by the throstle or the mule spinner. The difference in the motion and structure of these machines is not great. The former is similar to the bobbin and fly frame. The roving being unwound from the bobbin is elongated between three pairs of rollers, and is then spun and wound upon a bobbin as before. The greatest difference in these machines is in the spindles. The oldest is the live spindle, and the dead spindle is that invented at Lowell, and that which has been most used here. The ring spindle of Jenks is fast superseding both. The thread being spun by any of these means is wound upon bobbins, and these are then set in a frame in such a manner that the threads can be wound off from them on to a large six-sided reel. This, one and a half yards in circumference, makes 560 revolutions, giving the length of a "hank;" many hanks are wound on the reel at the same time, and when these are removed and weighed they give the number of the yarn. The coarsest yarn weighs half a pound to the hank, or 840 yards; common quality gives ten to forty hanks to the pound. The finest seldom exceeds 300 hanks to the pound. Previous to 1840 no yarn finer than 350 was made in England; at the World's Fair there was some exhibited 600, and some muslin for a dress for the queen was made of 460 yarn. This exceeds the "fairy tissues" of the east, mentioned in the fore part of this article. Thus machinery has overtaken eastern hand art. It has been stated that yarn has been spun 900, and one specimen of No. 2,150, or 1,026 miles for a pound of cotton!

The finest yarns are singed by being run through a gas flame; they are then passed over a brush and run through a hole in a piece of brass just large enough to admit the yarn. Any inequality then stops the yarn and is immediately remedied. Upon most of the machines, throstles, and feeders there are clocks, which, wound up once a week, mark the quantity of work that each machine does. From this register the account is transferred to a board which hangs in sight of all the operatives, and from which the monthly wages are ascertained.

The yarn being spun, the filling is now ready for the weaver, but the warp goes to the dressing-room. Here the yarn is warped off from the spools on to the section beams. This is considered hard work, since it requires unremitting attention to reconnect the threads that are constantly breaking. The yarn now upon the beams undergoes "dressing," or the application of the size before mentioned, and the friction of the brushes. The beams containing the dressed yarn go to the weaving-room, which usually is a large mill containing one hundred and fifty girls, and some six hundred looms. From this room the woven fabric goes to the cloth-room, where it is trimmed, measured, folded, and recorded, and either baled for market or sent to the print-works.

The print-works are a most interesting portion of the manufacture. The cloth received from the manufactory is covered with a fine nap, which, if printed, would rise up and give the colored parts a pepper-and-salt look. To get rid of this, the cloth is singed; not as the cook singes a fowl, by a blaze, but by running the cloth over a half-cylinder of copper, heated red hot. The cloth is passed over dry, and repassed; after which it is moistened by wet rollers, to extinguish any shreds which might happen to be on fire. This singeing process always excites the wonder of the beholder, who is not a little astonished that the cloth is not injured. The next process is to bleach the cloth. On the success of this depends all the after-work. A good white is not only the soul of a print, but without it no good and brilliant color can be dyed. The greatest difficulty is to remove every trace of grease and oil, imparted by the spinner and weaver. The cloth is, therefore, put into big tubs, holding five hundred pieces, and steeped in warm water some hours. It is then washed in the dash-wheel, and subjected to the following operations, which convert the oil to soap, and remove with it the coloring matter:—

1. Boiled by steam in a creamy lime.
2. Washed in the dash-wheel.
3. Boiled in alkali by steam.
4. Washed in the dash-wheel.
5. Steeped in bleaching-powder solution some hours.
6. Steeped in oil vitriol and water, about the strength of lemon juice.
7. Washed in the dash-wheel.
8. Squeezed between rollers.
9. Mangled and dried in air, or in warm rooms built for this purpose.

The cloth is now perfectly white, and loses not so much in weight and strength as by the old process of grass bleaching. The bleached cloth is now printed with one or more colors. Four to six colors only could be applied by the printing machine up to 1845 ; if more were wanted, they were, until recently, introduced by hand, with blocks, after the other colors were finished. By a Boston invention, patented in 1851, twelve colors may now be printed. The improvement consists in the mode of applying pressure to the print rollers. A yielding pressure of several tons is given to each roller. The frame is also so constructed that any one of the rollers may be removed from the machine without disturbing the others. The machine weighs ten tons, and is ten feet high. This huge machine is so nicely adjusted that the cloth, while passing through it at the rate of a *mile per hour*, receives twelve colors each with the utmost precision. Ordinary machines will print 300 pieces, or 12,000 yards, per day, while, by the old hand process, it would have required 192,646 applications of the block. The figure, or design, is engraved on a copper roller, each color having a separate roller. The color which the beholder sees imprinted, as he watches the process, is not the color that is to be, when the print is finished. The color which he sees is, with the exception of brown, or blue, or black occasionally, fugitive. It is merely what is called "sightening"—that is, a color imparted to the paste, or "thickening," which is imprinted by the roller to enable the machine printer to judge of the perfectness of the work. The paste, or *thickening*, contains the mordant—that is, the peculiar substance which, combining chemically with the cloth, enables it to dye a peculiar color, according to the nature of the mordant and dye-wood. The cloth dyes only where the mordant is applied—that is, on the printed figure only. The mordants generally used are alum and copperas, each of which is first changed to *acetate of alumina or iron*—that is, the color-maker takes away the oil of vitriol from the alum and copperas, and substitutes vinegar in its place. Sometimes the *iron liquor*, as it is called, is made by dissolving iron turnings in pyroligneous or wood acid. The preparation of color, and the thickening it with flour, starch, gum, etc., is a distinct branch, carried on in the color shop of the print-works. It may be added, that with madder, iron dyes black and purple, according to its strength; alum dyes red of various shades; and a mixture of the two dyes chocolate. So that out of the same dye-kettle come various colors, according to the mordant, and these colors are all fast.

The cloth having been printed and dried, is "aged," during which a chemical combination takes place between the mordant and the cloth. Ordinarily, this occurs in two or three weeks by a natural affinity of the cotton fibre and mordant, but by certain agents, this chemical change is hastened and perfectly effected in two or three days; yet as this process goes on in conjunction with the others, the visitor sees only the folding up and winding into rolls of the piece of cloth, though all the time this change is going on. The cloth is then passed, by means of rollers, through a boiling hot solution of *phosphate of soda*, to render insoluble any uncombined mordant, and to wet the cloth evenly. It is then washed in the dash-wheel, and after this, to remove the *thickening*, passed for twenty or thirty minutes through bran or meal and water, quite hot, washed, and it is now ready for dyeing. The dye-woods used are madder, bark, or logwood—the last only for mourning prints, or black and white. The dye-wood is put into large wooden vats, with a portion of water, and then the pieces of cloth, sixteen in each vat, are introduced over a winch, moved by water power. Steam is then admitted, the goods turned through and through, round and round, gradually heating the water, till at the end of two hours it rises near to boiling, and the mordanted cloth is perfectly dyed. It is taken out, rinsed, and washed in the dash-wheel. The cloth after this is passed, by means of a winch, either through hot water and bran or through hot soap, for half an hour, washed, and then again put through these operations, again washed, and then rinsed through a hot solution of chloride of soda, washed again, squeezed, and dried in either air or in warm rooms. Sometimes they are mangled with some stiffening, and so are finished. The visitor of print works will see a great number of men busily employed dipping wooden frames, on which are stretched pieces of cloth, printed with a brown figure, into deep vats, filled with a green-blue liquor. The cloth comes out with a *greenish* hue, and immediately grows blue in the air on all parts, except where the brown figure was. That *resists*, or *throws off* the blue vat. Now, the blue vat contains a solution of indigo in lime water. Indigo is one of the most insoluble substances in water;

but by means of copperas and lime, the oxygen of the indigo is abstracted by the iron; it then becomes greenish and is dissolved by the lime-water. Exposed to air, it again absorbs oxygen and becomes blue. It is during this change from green to blue that it becomes chemically united to the cloth. The brown figure *resists*, because it is a preparation of copper, which yields its oxygen to the indigo on the figure while in the vat. The figure becomes covered with blue indigo in the vat; it forms then no affinity with the cloth, and consequently after the copper has been removed by a weak acid, the brown spot or figure remains white, and so is produced the blue ground with white figures. The whole is a most exquisite chemical process from beginning to end, equalled only by the process for China blue, where blue figures are raised on a white ground. This is done by printing on the figure with fine ground indigo thickened with paste, and then by alternate immersions in lime water and copperas liquor, the indigo is dissolved and fixed on the spots where printed, by a play of chemical affinities similar to those described in blue dipping. Black and white, and red or chocolate and white, are made by passing the cloth through red or iron liquor, or their mixture, and after squeezing, while the cloth is open and flat, that is dried in hot flues. Every part of the cloth is thus imbued with mordant. The process is termed "pading." It is then printed with citric acid (lemon juice) thickened with roasted starch. This acid discharges the mordant, and consequently, when dyed as usual, the discharged figures are left white. Logwood is the dye for black, and madder is the dye for reds and chocolates. The designing of patterns is a distinct branch of art. Usually, one or more designers are employed in each establishment.

In the year 1840, there were thirty-six cotton-printing establishments in the United States. These were in New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania, and Maryland. They printed 100,112,000 yards, at a value of $11,667,512.

The exports of cotton goods from the United States in 1827 were valued at $951,000 for plain white cloths; $45,120 printed and colored; $163,293 for yarn, etc.; making together $1,159,413. In 1857, the exports of white had run to $3,463,230; and of printed to $1,785,685; dark and other manufacture $866,262; together, $6,115,117. In 1878, the exports of cotton manufactures were $11,438,660; in 1880, partly from reduction in price, they were $9,981,418. The exports were most largely to England (⅓ of the whole), to South America, Africa, China, and Japan. The value of cotton goods imported in 1856 was $25,917,999; and the average for sixteen years previous was $16,758,418. In 1880, the importation of cotton manufactures was $29,929,366. The imported goods were nearly all from France, Germany, Great Britain, and Ireland, and in 1877, '78, and '79, averaged $19,310,987.

| | Horse power. | Spindles. | Looms. | Cotton used, lbs. |
|---|---|---|---|---|
| 1851, | 134,217 | 25,638,114 | 301,445 | 757,379,749 |
| 1857, | 161,435 | 33,503,580 | 369,205 | 1,023,886,528 |
| 1868, | .... | 32,000,014 | 379,329 | 1,005,463,536 |
| 1876, | .... | 51,077,243 | 667,711 | 1,284,552,976 |

The following comparative figures will show the decline in the cost of the yarn, as a result of machinery;—

| No. 40 yarn. | 1812. | 1830. | 1857. |
|---|---|---|---|
| Hanks per spindle per day. | 200 | 275 | 275 |
| Cotton per lb. | $0 36 | $0 14 | $0 12 |
| Labor " " | 0 24 | 0 15 | 0 10 |
| Cost yarn " | 0 60 | 0 29 | 0 22 |

The manufacture progressed in this country according to the wants of the population, and these wants increased in the two-fold ratio of more means and greater numbers. The progress here was also more steady than it is abroad, for the reason that the demands of the people were not curtailed by those periodical famines, which abroad cause every other consideration to yield to that of food. We may sum in the following table the progress of the manufacture since 1809:—

COTTON MANUFACTURE IN THE UNITED STATES.

| | No. of Factories. | Spindles. | Hands. | Cotton used. lbs. | Yards cloth made. | Capital. |
|---|---|---|---|---|---|---|
| 1809 | 62 | 31,000 | 4,000 | 3,600,000 | .. | .. |
| 1820 | .. | 250,572 | .. | 9,945,609 | .. | .. |
| 1831 | 795 | 1,246,503 | 57,466 | 77,757,316 | 230,461,990 | $40,614,984 |
| 1840 | 1,240 | 2,284,631 | 72,119 | 132,835,856 | 398,507,568 | 51,102,359 |
| 1850 | 1,074 | 4,052,000 | 97,956 | 276,074,100 | 828,222,300 | 76,032,578 |
| 1860 | 1,091 | 5,235,727 | 122,028 | 422,704,975 | 1,148,252,406 | 98,585,269 |
| 1869 | 831 | 7,023,883 | .. | 470,000,000 | 1,410,000,000 | .. |
| 1870 | 969 | 7,023,883 | 135,763 | 470,000,000 | 1,410,000,000 | 140,907,882 |
| 1880 | .. | 10,921,147 | 181,628 | 761,770,880 | .. | .. |

The figures for 1809 are those of Mr. Gallatin, and those of 1820 those of the United States marshal. Those for 1831 are taken from the report of the committee before alluded to, and the succeeding ones from the decennial censuses. The war, of course, effected material changes in the cotton manufacture, both in enhancing the cost of the raw material and the manufactured product. The manufacture of cotton yarns in the south and southwest at one time almost entirely ceased, and the supply of cotton goods in that section was obtained from England, and only by running the blockade. The price of bleached cotton shirtings and sheetings, of good brands, went up to 75 or 80 cents per yard for goods sold at 10 cents per yard or below, in 1861. Spool cotton brought $1.25 to $1.50 per dozen, against 35 to 45 cents, in 1861. Since the close of the war many new cotton manufactories have been started in the south. The total number of factories has somewhat diminished, but those running are larger, and the number of spindles, the amount of cotton used, and the number of yards made is about 75 per cent. greater than in 1860. The quality of the printed goods is better than it was at that time, though that of the bleached goods is not, owing to the introduction of short staple cotton in the weft. The manufacture will, doubtless, increase greatly, and especially in the southern states, where a considerable saving can be effected in the transportation of cotton, and where a demand for better qualities of cotton goods is springing up. The female operatives at the south, are mostly from the families of the poor whites, though a few factories employ colored women. In the north, the American-born factory girls, farmers' daughters, have almost wholly given place to Irish, German, Swedish, and French women of less intelligence, and who are willing, generally, to work at somewhat lower wages.

# PAPER: ITS MANUFACTURE.

## CHAPTER I.

### MATERIALS—PROGRESS.

If the question were put, "What single article has been of the greatest service to mankind?" mature reflection would, we think, decide upon paper as that article, since it has been the means by which thought and ideas have been diffused, not only among cotemporaries, but preserved, and, as it were, accumulated in magazines for future expansion and growth. All other inventions, and perhaps the whole growth of civilization, are due to the material of paper. Every branch of knowledge is reached, and every avenue to the wisdom of great minds and the results of genius are explored only by means of paper, and its blessings are diffused through all ranks of society. Even he who, wrapt in his ignorance, despises "book larning," enjoys a part of those benefits of civilization which paper has been the means of imparting to all. Like almost all great blessings, however, it has been developed most rapidly and completely in the United States. Almost all vegetable substances were used for the manufacture of paper by our ancestors, but it was not until the fourteenth century that linen rags became generally the material. The first German paper mill was established at Nuremberg in 1390; some English manuscripts, however, date as far back as 1340, on linen paper. The first English mill mentioned is in 1496, by John Tate, jun., in Hertfordshire. In 1588 a paper mill was started at Dartford. It is to be conceived, however, that in that age, when books and newspapers were little used, and walls were draped with cloth, that paper was not much in demand, and many improvements were not made in the manufacture. In the early part of the eighteenth century, the manufacture was introduced into the colonies. Mr. J. M. Willcox, a paper maker near Philadelphia, stated that in 1725 his grandfather, who had been educated a paper maker, came over and settled where the mill now is, and he erected in 1732 a mill for the manufacture of paper. The kind of paper then made was of the description used by clothiers for press-boards, for the pressing of cloth. There existed at that time an act of parliament against the manufacture of any other kind of paper in the colonies. There were at that time two other mills in the same business, one near Boston and another near Philadelphia. The demand for paper at that time, either for books or newspapers, was small, and not of a character to attract much capital into the business. When the war came on, a demand sprung up, and Mr. Willcox manufactured the paper for the continental money, and at the same time commenced making writing paper for the first time in America.

The Massachusetts Bay assembly, in 1728, passed an act for the encouragement of the paper manufacture. They granted to Daniel Henchman and others the right of making paper, on condition that within the first fifteen months they would make 140 reams of brown paper and sixty reams of printing paper. Of this the board of trade report of 1731 says: "By a paper mill set up three years ago, they make to the value of £200." This, with the mill of Willcox and another near Philadelphia, were the only ones existing at that time; but the trade grew to a considerable extent. Coxe, in his "Views of the United States," says there were in 1794 forty-eight mills in Pennsylvania. In 1810, the value of paper made in the United States was about $2,000,000. The general government, from its origin, did what it could to encourage the manufacture, by making rags free; curiously enough, however, after the fall of Napoleon, a considerable quantity of paper came to this country, and was bought up by the contractors to supply Congress; and for a long time, up to 1825, the paper used by the United States Senate bore the water line, "Napoleon, Empereur et Roi, 1813."

It was about the year 1760 that the invention of wove moulds was made to obviate the roughness of *laid* paper. This led to the manufacture in France of what is called vellum paper. In Holland, soon after, the manufacture was improved by the invention of cylinders with long steel knives to reduce the rags to pulp, thus superseding the old plan, which was by stampers. It was then customary to pile the rags in large stone vats, and let them remain for a month or six weeks to ferment and rot by soaking and stirring in water. By these means the fibres became loosened, and sufficiently soft to be reduced to pulp in the large wooden stampers. The *vats* were now supplanted by *engines*. These are arranged in pairs. That which first receives the rags is called the washer, working the rags coarsely, while a stream of water runs through them. The contents of this vat, when ready, is called *half stuff*, and is let off into the other engine, which is on a lower level, and this beats or grinds the whole into pulp for making paper.

From the date of the Revolution until the year 1820, there was very little improvement in the mode of making paper by machinery. The number of mills increased in proportion to the demand for material for newspapers and book-making. This grew in such a manner, that by the year 1810 the ordinary supplies of material for paper making began to fail, and rags from Europe were imported in greater quantities for that purpose. The principal supplies of rags in the United States came from the economy of families, purchased by ragmen who called—sometimes paying money, and at others exchanging tinware and other commodities. It is only of late years, and that in the large cities, that the European *chiffonniers*, or rag-pickers, have made their appearance. These are now to be seen, male and female, with the early dawn, armed with a bag and a long iron hook, watching the opening and sweeping out of stores, to pick up every shred of rag or paper, and following the gutters the live-long day, thrusting the iron hook into filth of all descriptions to fish out matter for the paper maker. This they rinse in the nearest puddle, and deposit in their bag. Many of them earn a fair living at this unpromising occupation. Nevertheless, the supply is very inadequate, and large importations are resorted to. The quantity of imports is as follows:—

IMPORTATION OF RAGS INTO THE UNITED STATES.

| | Rags imported. lbs. | Of which from Italy. | Value. | Per lb. cts. |
|---|---|---|---|---|
| 1846, | 9,897,706 | 8,002,865 | $385,020 | 3.89 |
| 1848, | 17,014,587 | 13,803,036 | 626,136 | 3.68 |
| 1850, | 20,696,875 | 15,861,266 | 747,157 | 3.61 |
| 1851, | 26,094,701 | 18,512,673 | 902,876 | 3.46 |
| 1854, | 32,615,753 | 24,240,999 | 1,007,826 | 3.69 |
| 1857, | 44,582,080 | 27,317,580 | 1,448,125 | 3.27 |
| 1860, | 43,300,000 | 30,310,000 | 1,448,400 | 3.27 |
| 1862, | 5,088,449 | 7,567,703 | 241,738 | 2.69 |
| 1869, | 75,617,849 | 20,662,820 | 2,800,619 | 3.71 |
| 1872,* | 153,467,433 | 30,382,421 | 6,007,733 | 3.91 |
| 1875,* | 124,573,243 | 27,623,095 | 4,770,745 | 3.87 |
| 1877,* | 123,972,657 | 15,172,785 | 3,916,799 | 3.16 |
| 1879,* | 121,894,109 | 13,873,729 | 3,196,243 | 2.62 |
| 1880,* | 243,920,964 | 25,327,121 | 7,037,197 | 2.88 |

It may be remarked that the export of linen rags is strictly prohibited from Holland, Belgium, France, Spain, and Portugal. The import from Italy has ranged from 20 to 70 per cent. The rags thence derived are mostly linen which has been

* Including other paper stock imported.

used for outer garments, and which have become whitened by exposure to sun and air. That circumstance formerly gave them a value which they have lost since the improvements in bleaching all descriptions. The linen rags from the north of Europe are stronger and darker. The quantity of rags used in the United States in 1850 was, according to the value reported in the census, nearly 200,000,000 lbs., and 20,696,875 lbs. were imported in that year. The importation in 1880 was more than ten times this amount.

There have been apprehensions that the supply of available paper stock would, within a few years, be so far inadequate to supply the demand that the cost of paper would be greatly enhanced. Rags proved insufficient as long ago as 1862 or 1863, and resort was had to other materials. But these apprehensions seem to have been groundless, for the lack of rags has led to the utilization of other materials, and though paper and pulp are now used for a thousand purposes not then dreamed of, the supply seems to be adequate, and the manufacturers of some classes of papers have been compelled to restrict the production in order not to glut the market. There was a scarcity and consequent high prices during the war, but prices are not now materially higher than they were twenty years ago. A book written in Germany by M. Schäffer, so long ago as 1772, contains sixty specimens of paper made of as many different materials. Many of these materials are of no practical value, because they cannot be procured in large quantities and at a cheap rate; but there have been added to the catalogue: straw, which, after many years of experiment to retain the tenacity of the fiber, while depriving it of most of its silicious particles, is the principal source of supply for news and the cheaper book papers; wood pulp, which is also largely used, and considerable quantities imported; hop-bind, licorice root, the stalks of several species of mallow, the husks of Indian corn, the broken and unbroken stalks and fibrous covering of the flax and hemp, especially of the former, when raised for the seed; the stalks of the cotton plant, and the hulls or outer covering of the cotton seed, which has been found to be admirably adapted for making some qualities of paper; the canes, brakes, and giant rushes of the Carolina coast; the *tule* rush of California; the okra plant; the *esparto*, or Spanish grass, now so largely used in Great Britain, but not imported here to any practical extent; the bagasse, or crushed stalks of Indian corn and sorghum from which the juice has been expressed for sugar making; the palmetto, particularly the saw palmetto, so common on barren lands at the south, the *spartina* fiber of the Mississippi valley, and the aloes and agaves and some of the cacti of Texas, Arizona, New Mexico, and California. There is no difficulty in making paper from any fibrous plant. But for practical purposes it is necessary to know, in regard to any of these articles, whether the fiber can be furnished in sufficient quantity, and at a price so low as to compete successfully with other paper stock. Enormous as is the importation of rags, waste, etc., from Europe, and great as is the increase in the production of these articles in our own country, they do not supply one-third of the demand, and all the better sorts are reserved for writing papers. The industrious, but not particularly aesthetic or cleanly, *chiffoniers* gather from every ash barrel and from all the gutters and street sweepings every bit of rag or waste paper, and carefully sort these and sell them to the dealers in paper stock. All the newspapers, magazines, imperfections in book stock and government documents which are not needed for other uses, are gathered by these dealers. and the printer's ink being discharged from them by a bleaching process, they are transformed into white paper, or mingled with the straw and wood pulp to make printing paper of somewhat greater strength than that made from these materials alone. Of the other substances we have enumerated as adapted to paper making the following are now in use, or can be obtained in a quantity sufficiently abundant, and at a price low enough to warrant their extensive use: straw of most of the cereals; much of this is now burned in Minnesota, Dakota, California, and Oregon; wood pulp, mostly of the linden or basswood, birch, or soft maple; the stalks of the cotton plant, and hulls or outer covering of the cotton seed; it is estimated by Mr. Edward Atkinson, that 1,500,000 tons of this material could be furnished in the south from the annual cotton crop, an amount more than sufficient for all the paper made in the country. It is now practically valueless. On the Atlantic coast, below the Virginia line, the brakes, reeds, or bamboos of the Carolinas and Georgia, and the saw palmetto, are found in almost inexhaustible quantity; these make the best of paper. In the Mississippi valley, and on the plains of the region east of the Rocky Mountains, there is, in addition to the straw and the bagasse of the corn and sorghum stalks, and which latter will be a constantly increasing quantity, the *spartina* grass of the Mississippi and its tributaries, and the stalks of the flax which is largely sown for its seed in the new lands after the first breaking. The Pacific coast might furnish hundreds of thousands of tons of straw, and pulp from its fibrous woods and plants, and the southwest, as far east as Texas, has an unfailing supply of the finest paper stock in its giant cacti, which form dense jungles or chaparrals, which could be swept down by large mowing or reaping machines, greatly to the advantage of the inhabitants. There are also aloes, agaves, and tampico grasses, all of the best quality for this manufacture. There are, very possibly, still other materials equally well adapted for paper making, but these are certainly sufficient to supply our present necessities, and ought to relieve us from any obligation to import 7,000,000 lbs. of rags and other paper stock from Europe annually. The paper made from the cactus fiber is of unrivalled purity, beauty, and strength; no linen paper can compare with it. It can communicate no disease or poison, while the rags we import are a fruitful source of the propagation of smallpox and other contagious diseases.

The experience of the English paper manufacturers in the use of the *esparto* grass should lead our manufacturers to give more attention to the use of these fibers than they are doing. It is easier, no doubt, to use wood pulp (even if it is imported, as much of it now is) than to enter upon new manufacturers of fibrous material requiring a considerable plant, even though that material may produce a better and more satisfactory paper. Wood pulp does not make a very satisfactory paper; it answers for want of something better for newspapers, but the ragged and forlorn character of the daily newspaper after a day's handling testifies most forcibly to its lack of fibrous adhesion. Our English neighbors found this out, and yet what could they do? A paper made of rags would be too costly for the use of the cheap daily press, and there seemed at first to be no substitute. At length they learned from their French competitors to import the esparto grass, a tough fibrous heath from the plateaus of Algeria, Tunis, and Tripoli, and though the price of this has been greatly enhanced by the demand, they imported in 1879 more than $3,500,000 worth of it, and they use it in writing as well as in printing paper with great advantage. Our cotton stalks and seeds furnish a better paper stock in every respect than the esparto grass, and the saw palmetto and cactus fiber are better still.

The increase in the consumption of paper and paper pulp in the United States in the past thirty years has been enormous, amounting probably to tenfold the quantity consumed in 1850. As lately as 1872 we imported paper (aside from papier maché and other manufactures of paper pulp) to the amount of $1,235,000, while our exports were merely nominal; now our importations are only about $235,000, and some years not half that, while we export about $1,100,000 worth of paper annually. But though there has been a very great increase in the number of books, magazines, and newspapers printed, and in the writing papers consumed, the consumption of paper for other purposes than printing and writing has been vastly greater than for what we have been accustomed to regard as its more legitimate use. We have enumerated on a previous page many of these uses; we may add to the list, sheathing papers for houses and ships; roofing felt (so called); a soft manilla paper for stereotyping newspapers; paper combined with plaster for the inner walls of houses, for globes, and for all papier maché purposes; paper for doors, window frames, car wheels, boats, barrels and hogsheads for the transportation of sugar, lard, petroleum, oils, etc., soles of boots and shoes, twine, artificial flowers, bags for flour, meal, groceries, grain, and the lighter dry goods; indeed, bags for every purpose for which they can be used; for bridges, domes of observatories, for carbons, for electric lamps, for gas-fixtures, for brackets, and to replace all our hardest woods.

When the rags are received at the mill, they are sorted according to their respective qualities; for if rags of different qualities were ground together at the same engine, the finest and best parts would be ground and carried off before the coarser were sufficiently reduced to make a pulp. In the sorting of rags intended for the manufacture of fine paper, hems and seams are kept apart, and coarse cloth separated from fine. Cloth made of tow should be separated from that made of linen; cloth of hemp from cloth of flax. Even the degree of wear should be attended to, for if rags comparatively new are mixed with those which are much worn, by the time the first are reduced to a good pulp, the others are so completely ground up as to pass through the hair strainers, thus occasioning not only loss of material but loss of beauty in the paper; for the smooth, velvet softness of some papers may be produced by the finer particles thus carried off. The pulp produced from imperfectly sorted rags has a cloudy appearance, in consequence of some parts being less reduced than others, and the paper made from it is also cloudy or thicker in some parts than in others, as is evident on holding a sheet up before the light. When it is necessary to mix different qualities of materials, the rags should be ground separately, and the various pulps mixed together afterward. The rag merchants sort rags into five qualities, known as Nos. 1, 2, 3, 4, and 5. No. 1, or *superfine*, consisting wholly of linen, is used for the finest writing papers. No. 5 is canvas, and may, after bleaching, be used for inferior printing papers. There is also *rag-bagging*, or the canvas sacks in which the rags are packed, also cotton colored rags of all colors, but the blue is usually sorted out for making blue paper. Common papers are made from rag-bagging and cotton rags. An operation sometimes required after unpacking the rags is to put them into a *duster*, which is a cylinder four feet in diameter and five feet long, covered with a wire net, and inclosed in a tight box to confine the dust. A quantity of rags being put into this cylinder, it is made to rotate rapidly on its axis, and thus a great deal of dust is shaken out, which might otherwise vitiate the air of the rag-cutting room. The sorting is done by women and children in a large room. The rags are sorted, according to their fineness, into the *superfine*, the *fine*, the *stitches* of the fine, the *middling*, the *seams* and *stitches* of the middling, and the *coarse*. These divisions are more or less observed at the present day. The very coarse parts are rejected, or laid aside for making white-brown paper.

The paper was formerly made into sheets by means of the *mould* and *deckle*. The *mould* was a square frame or shallow box of mahogany, covered at the top with wire cloth; it is an inch or an inch and a half wider than the sheet of paper intended to be made upon it. The wire cloth of the *mould* varies in fineness with that of the paper and the nature of the stuff; it consists of a number of parallel wires stretched across a frame very near together, and tied fast through holes in the sides; a few other stronger wires are also placed across at right angles to the former; they are a considerable distance apart, and are bound to the small wires at the points of intersection by means of fine wires. In several kinds of writing paper the marks of the wires are evident, from the paper being thinner in the parts where the pulp touches the wires. In what is called *wove* paper, there are no marks of the wires; these are avoided by weaving the wire in a loom into a wire cloth, which is stretched over the frame of a mould, and being turned down over the sides is fastened by fine wire.

The *water-mark* in paper is produced by wires bent into the shape of the required letter or device, and sewed to the surface of the mould; it has the effect of making the paper thinner in those places. The old makers employed water-marks of an eccentric kind. Those of Caxton and other early printers were an ox head and star, a collared dog's head, a crown, a shield, a jug, etc. A fool's cap and bells employed as a water-mark gave the name to foolscap paper; a postman's horn, such as was formerly in use, gave the name to post paper. Connected with the sizing of papers is the blueing, which is said to have originated in the suggestion of a paper maker's wife, who thought that the practice of improving the color of linen while passing through the wash, by means of a blue-bag, might also be advantageously applied to paper. A blue-bag was accordingly suspended in the vat, and the effect proved to be so satisfactory that it led to the introduction of the large and important class of blue writing paper. It was soon found that smalt gave a better color than common stone-blue, and smalt continued to be used for many years; but when artificial ultramarine came to be manufactured at a very low cost, and in a great variety of tints, this beautiful color gradually superseded smalt in the manufacture of writing paper.

From 1820 to 1830, some efforts were made to introduce into the United States machinery from Europe. England and France were before us in its introduction. Several machines were sent out from England; some very imperfect, and the cost too great for our manufacture. The patronage then offered was no inducement to our own machinists to construct so expensive a machine until 1830, about which time Phelps & Spofford of Windham, Connecticut, made one which answered very well. Soon after, the country was supplied at a reasonable cost, and equal in quality to the best English. Not long afterward, Howe & Goddard, of Worcester, Massachusetts, commenced making the Fourdrinier—the shaking endless wire-web machine. The *cylinder* machine, more simple and less costly than the other, is in more general use; but the paper made on it is not equal in quality. Notwithstanding, it does very well for news, and the various purposes which a coarser article will answer for. These are made in various places throughout the United States. The interval from 1830 to 1840 was important for the vast improvements in the manufacture, by the application of this kind of machinery for that purpose; also, by the introduction of the use of chlorine in the form of gas, of chloride of lime, and the alkalies, lime and soda-ash, in bleaching, cleansing, and discharging the colors from calicoes, worn out sails, refuse tarred rope, hemp bagging, and cotton waste, the refuse of the cotton mills. These articles, which heretofore had been considered only applicable for the manufacture of coarse wrapping paper, have, through the application of this bleaching and cleansing process, entered largely into the composition of news and coarse printing papers, and consequently have risen in value 300 per cent. A few mills possess machinery and adopt a process by which they are prepared for the finest printing and letter paper. A beautiful paper is made of cast-off cable rope. Hemp bagging is an excellent material for giving strength, and is in great demand, especially for making the best news paper. The cost of making paper by machinery, compared with that of making it by the old method (by hand), not taking into account the interest on cost and repair of machinery, is about as one to eight. The mills which have been using straw in great quantities within a few years past, found some modification of their machinery necessary to enable them to succeed with their new material. The manufactories using the North Carolina brake or swamp cane, (a species of bamboos,) reduced it to paper pulp or fibre, by subjecting it to steam in an iron cylinder for some time and then suddenly exploding it as they would a cannon, by the propulsive force of steam, against a solid stone wall. It was in this way torn into a mass of fine fibres, suitable for paper pulp. The other materials now used for paper, all require a somewhat different treatment from rags; some of them are much stronger than even the best linen rags. The spartina fibre found in the marshy bottoms of the Mississippi River and its tributaries, makes a remarkably tough and handsome paper under proper treatment, sufficiently strong for bank-note purposes, and its coarser qualities make excellent flour bags. Paper is now made in all sections of the country. Some of the best specimens of paper come from the Mississippi valley, where formerly it was thought that the water was not pure enough to make fine paper.



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## CHAPTER II.

### INVENTIONS—MANUFACTURE.

The slow and difficult process of moulding the separate sheets of paper by hand, has to a very great extent been superseded by the introduction and gradual improvement of the very beautiful machinery of Fourdrinier. By means of this machine, a process which, under the old hand system, occupied a couple of weeks, is now performed in a few minutes. Within this brief space of time, and the short distance of thirty or forty feet, a continuous stream of fluid pulp is made into paper, dried, polished, and cut up into separate sheets ready for use. The paper thus produced is moderate in price, and, for a large number of purposes, superior in quality to that which was formerly made by hand. In fact, the machine-made papers can be produced of unlimited dimensions; they are of uniform thickness; they can be fabricated at any season of the year; they do not require to be sorted, trimmed, and hung up in the drying-house—operations which formerly led to so much waste that about one sheet in every five was defective. The paper machine moves at the rate of from twenty-five to forty feet per minute, so that scarcely *two minutes* are occupied in converting liquid pulp into finished paper, a result which, by the old process, occupied about *seven* or *eight days.* If the machine produce ten lineal yards of paper per minute, or six hundred yards per hour, this is equal to a mile of paper in three hours, or four miles per day of twelve hours. The paper is about fifty-four inches wide, and supposing three hundred machines to be at work on an average twelve hours a day, the aggregate length of web would be equal to 1,200 miles, and the area 3,000,000 square yards.

Paper is sent into market in various forms and sizes, according to the use for which it is intended. The following table contains the names and dimensions of various sheets of paper.

| | Inches. |
|---|---|
| Foolscap | 14 by 17 |
| Crown | 15 " 20 |
| Folio post | 16 " 21 |
| Demy | 17 " 22 |
| Medium | 19 " 24 |
| Royal | 20 " 25 |
| Super-royal | 22 " 27 |
| Imperial | 22 " 32 |
| Medium and half | 24 " 28½ |
| Royal and half | 25 " 29 |
| Double Medium | 24 " 38 |
| Double super-royal | 27 " 42 |
| Double imperial | 32 " 44 |

Many of the papers above enumerated are made by hand of the exact size indicated, but if made by the machine, the roll of paper has to be cut to the required dimensions. In order to do this with precision and expedition, various cutting machines have been contrived, in which the paper, as it comes from the manufacturing machine, is cut to any size required. Fine papers are, in many cases, hot-pressed and glazed. In hot-pressing, a number of stout cast iron plates are heated in an oven, and then put into a screw press in alternate layers, with highly glazed paste-boards, between which the paper is placed in open sheets ; and the hard-polished surface of the pasteboards, aided by the heat and pressure, imparts that beautiful appearance which belongs to hot-pressed paper. A yet more smooth and elegant surface is produced by the process of glazing. The sheets of paper are placed separately between very smooth, clean, copper plates. These are then passed through rollers, which impart a pressure of twenty to thirty tons. After three or four such pressures the paper acquires a higher surface, and is then called glazed. The general introduction of steel pens has increased the demand for smooth papers, and has led to improvements in finishing them. As an improvement in the manufacture of paper sized by the machines now in use, it is proposed to conduct the web of paper, after it has been either partially or completely dried, through a trough of cold water, then to pass it through a pair of pressing rollers, and afterward to dry it on reels, or over hot cylinders. The paper which has been thus treated will be found to "bear" much better, and admit of erasures being made on its surface, and written over, without the ink running in the way it does when the paper is sized and dried in the usual manner. It has been found that when paper is dried, after sizing, by the drying machines in present use, the paper is very harsh, and until it stands for some time to get weather (as it is technically termed) great difficulty is experienced in glazing the paper. This inconvenience is proposed to be overcome by passing the paper partially round a hollow cylinder, through which a small stream of cold water is made to run. By this means the heat is carried off, and the paper is rendered more tractable, and brought to a proper state for undergoing the glazing operation.

We may describe the modern process of paper making, by detailing the operations as carried on in large mills. The visitor goes up to the second story, into a room some sixty by eighty feet, in which girls are engaged assorting the rags. Here are numerous bales of white rags, foreign and domestic. The imported are linen, the others cotton. In the same room these rags are cut by a machine, driven by power, which fits them for the subsequent processes. They are next sent into a rotary boiler of about two tuns capacity, into which steam is admitted, and the rags boiled. Next they are cast down on a floor in the first story, where they are put into cars, on which they are conveyed to the washing engines. Two engines are employed in washing, called rag engines. These engines play in tubs of an oval form, of large capacity, each containing perhaps 200 lbs. of rags. The impelling power, steam or water, causes the revolution of a roller, set with knives or bars of cast steel inserted in it longitudinally. This roller is suspended on what is called a *lighter*, by which it may be raised or lowered at pleasure upon a plate, consisting of bars of steel, set up edgewise. Passing now between this and the plate, the rags are reduced to fibre. A stream of pure water is then conveyed into the rag engine, and, by means of a cylinder covered with gauze wire, the dirty water is passed off. This cylinder, called a patent washer, is octagonal in shape, some thirty inches in length, revolving in the engine, and having buckets within it, corresponding with the sides of the washer. By this process the rags are washed perfectly clean in from three to six hours.

The bleaching process is performed by the insertion into this engine of a strong solution of the chloride of lime and some acid, to cause a reaction. The pulp is then emptied into large cisterns, covered with the bleach liquor it contains, where it is allowed to remain from twelve to twenty-four hours to bleach. It is then drained, put into the beating engine, and reduced to a pulp, the consistency of milk, which it much resembles. This pulp is emptied into a large cistern, in a vault beneath, and kept in motion by means of an agitator revolving in it. It is then raised by a lifting pump into a small cistern, from which it is drawn off by a cock—which is opened more or less, according to the thickness of the paper intended to be made—on to a strainer, which removes the knots, sand, or hard substances that may damage the paper, and then flows upon a leathern apron, which conducts it to an endless wire cloth, over which the web of paper is formed. This wire cloth is kept constantly vibrating, which both facilitates the escape of water and the felting together of the fibres of the pulp. The wire cloth, with the pulp upon it—the edges being protected by deckle-straps—passes on until it comes to a couple of *wet-press* cylinders, as they are called, the lower of which is of metal, but covered with a jacket of felting or flannel; the upper one is of wood, made hollow, and covered first with mahogany, and then with flannel. These cylinders give the gauze with the pulp upon it a slight pressure, which is repeated upon a second pair of wet-press rolls similar to the first. The paper is then fed upon an endless felt or blanket, which travels at exactly the same rate as the wire cloth, while the latter passes under the cylinders, and proceeds to take up a new supply of pulp. The endless felt conveys the paper, still in a very wet state, between cast iron cylinders, where it undergoes a severe pressure, which rids it of much of the remaining water, and then between a second pair of press-rollers, which remove the mark of the felt from the under surface; and finally it is passed over the surface of cylinders heated by steam, and when it has passed over about thirty lineal feet of heated surface, it is wound upon a reel ready for cutting. Forty years ago three men could by hand manufacture 4,000 sheets in a day. The same number now by the aid of machinery will make 60,000.

From the time of the Revolution the quantity of paper imported has been gradually decreasing; and before the revision of the tariff in 1846, had dwindled to perhaps not more than 2 per cent. of the amount consumed, with the exception of wall papers, of which considerable quantities were and still are imported from France and England. The importations now of writing and drawing papers consist of moderate quantities of thin French and German paper, mainly for foreign or fancy correspondence, and drawing paper and bristol boards from England, France, and Austria. The reduced price of machine paper has forced almost all manufacturers to abandon the old hand method. There were, a few years since, only two mills in operation in the United States in which it was made by hand—one in Massachusetts and one in Pennsylvania. There is a limited quantity of peculiar kinds, that can be better made by hand than on a machine, such as bank-note, laid letter, deed parchments, and such as are used for documents that are much handled, and require great strength and durability. Within the last few years some improvement has been made in the finish of writing and printing papers, by the introduction of iron and paper calenders for the purpose of giving a smooth surface. The finish of American papers is now equal to any in the world.

The quantity of paper required for the newspaper service of the country is probably 320,000,000 lbs. per annum, which would allow a circulation of 1,600,000,000 sheets. There would remain 280,000,000 lbs. of paper for the service of the book trade, and the trade and publications of the religious societies, and about 100,000,000 lbs. for other purposes.

The use of paper in part or wholly for collars, cuffs, shirt fronts, etc., etc., has attained its present magnitude almost entirely since 1860. It now employs a large capital and uses between five and six millions of dollars' worth of paper. Its use for building purposes is also very large, being coated with a composition and used for sheathing, in the place of boards; saturated with tar, and under the name of roofing felt made the basis of the "felt and gravel roofs;" combined with gypsum and made into blocks for the walls of the rooms; made into papier maché and compressed into doors and window-sash of great beauty and cheapness, and moulded into door-knobs and trimmings.

The use of paper-hangings, which has become so common in the past twenty years, superseding hard finish and painted walls, for city dwellings, absorbs a large amount of paper. In Philadelphia the consumption of paper for hangings has been yearly 1,500 tons, or 3,000,000 lbs. The paper used for this purpose is heavy, and comes from the mill in rolls of 1,200 yards long, and from 20 to 35 inches wide. It costs from 6 to 12 cents per pound. In the preparation of this paper the pattern is first carefully drawn from original designs, and then printed. The outlines of the various tints were made each upon a separate block, made of pear-tree, mounted with pine. The color was contained in sieves, and the blocks thus applied to these were laid upon the paper, following each other upon the guide-marks left by the previous impressions. It is stated that a paper-hanging exhibited at the World's Fair, and representing a chase in a forest with birds and animals, required 12,000 blocks. The manufacture of wall papers has greatly improved in the last decade. Many of them are now of very rich patterns, and all the better qualities are printed from cylinders, block printing being almost entirely abandoned. The quantity manufactured here has largely increased.

In making what is called flock (shearings of broadcloth) paper, the pattern is printed in size and varnished; the wool then being sifted on the varnished pattern, adheres to it. Satin papers are finished with powdered steatite and polished.

STATISTICS OF PAPER MANUFACTURE IN 1850, 1860, AND 1870.

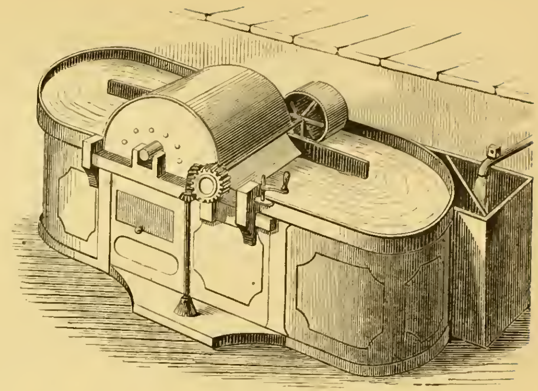
| 1850. Classes. | No. of Establishments. | Hands Employed. | | | | Capital. | Wages. | Material. | Products. |
|---|---|---|---|---|---|---|---|---|---|
| | | All. | Males. | Females. | Youth. | | | | |
| Paper Mills, | 443 | 6,785 | 3,835 | 2,950 | .... | $7,260.864 | $1,497.792 | $5,555,929 | $10,187,177 |
| Paper Card Factories, | 2 | 35 | 13 | 22 | .... | 21,000 | 7,320 | 21,350 | 37,500 |
| Paper Staining, | 38 | 803 | 753 | 50 | .... | 547,700 | 166,288 | 314,291 | 741.540 |
| Totals, | 483 | 7,623 | 4,601 | 3,022 | .... | $7,829,564 | $1,671,400 | $5,891,570 | $10,966,217 |

| 1860. Classes. | No. of Establishments. | Hands Employed. | | | | Capital. | Wages. | Material. | Products. |
|---|---|---|---|---|---|---|---|---|---|
| | | All. | Males. | Females. | Youth. | | | | |
| Paper, | 555 | 10,911 | 6,519 | 4,392 | .... | $14,052,683 | $2,767,212 | $11,602,266 | $21,216,802 |
| Paper Bags, | 2 | 14 | 5 | 9 | .... | 11,000 | 2,460 | 12.200 | 21.500 |
| Paper Hangings, | 26 | 1,294 | 1,203 | 91 | .... | 1,037,600 | 328,224 | 1,153,670 | 2,148,800 |
| Paper Shades. | 1 | 6 | 6 | .... | .... | 10,000 | 6,300 | 5,000 | 25,000 |
| Totals, | 584 | 12,225 | 7,733 | 4,492 | .... | $15,111,283 | $3,104,196 | $12,773,136 | $23,412,102 |

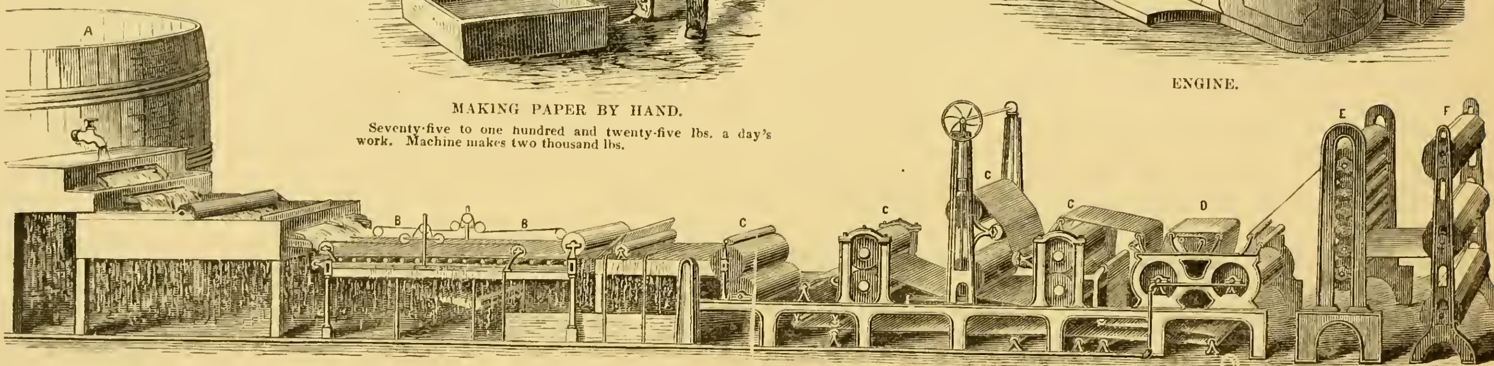
| 1870. Classes. | No. of Establishments. | Hands Employed. | | | | Capital. | Wages. | Material. | Products. |
|---|---|---|---|---|---|---|---|---|---|
| | | All. | Males. | Females. | Youth. | | | | |
| Paper, n. s., | 163 | 2,770 | 1,902 | 741 | 127 | $5,001,820 | $1,028,208 | $3,478,709 | $6,406,817 |
| Paper, Printing, | 235 | 8.167 | 5,107 | 2,553 | 507 | 16,771.920 | 3,400.038 | 16,120,363 | 25,200,417 |
| Paper, Wrapping, | 225 | 3.111 | 2.462 | 475 | 174 | 6,276,600 | 1,219,821 | 4,420,240 | 7,706,317 |
| Paper, Writing, | 46 | 3.862 | 1,450 | 2,384 | 28 | 6,314,674 | 1,470,446 | 6,009,751 | 9,363,384 |
| Paper Hangings, | 15 | 869 | 558 | 145 | 166 | 1,415,500 | 329,267 | 1,315,106 | 2,165,510 |
| Totals, | 684 | 18,779 | 11,479 | 6,298 | 1,002 | $35,780,514 | $7,477,780 | $31,344,167 | $50,842,435 |

MAKING PAPER BY HAND.

Seventy-five to one hundred and twenty-five lbs. a day's work. Machine makes two thousand lbs.



ENGINE.




FOURDRINIER PAPER MACHINES.

The pulp is drawn from the stuff-chest A into the va. and screen G; passing along over the Fourdrinier wire or fine wire-cloth B B, it enters on a heavy felt which passes between several sets of rolls C C C C, by which time the paper becomes well formed; it then passes through the dryers D, which are heated by steam; thence to the finishing rolls or calenders; from these to the reels. The pulp on leaving the stuff-chest we should say consists of 49-50ths of water. The process of draining is very rapid in passing over the wire-cloth; in addition to the natural drain, it passes the flat surface of half round copper cylinders punctured with holes; these are exhausted by suction pumps. Machines are from 50 to 70 and 80 feet in length, and 4 to 7 feet in width. For want of room we show only two drying cylinders and one stack of finishing calenders. From four to eight of the former and one to three of the latter are used, exact duplicates. When paper is sent to market in reams instead of rolls, there is a cutter attached which cuts the paper the required size; it consists of revolving shears, one blade stationary. There is also a sizing apparatus attached when animal size is required, consisting of vat for size and cylinders. The whole is moved by a system of gearing and pulleys (not shown, being back of the machine,) the whole so devised as to move in perfect harmony, termed the draw of the machine.

STATISTICS OF PAPER MANUFACTURE IN 1872.
LOCKWOOD'S TABLES.

| No. of Paper Mills. | Value or Capital. | Machines. | | Engines. | Hands Employed. | | | | Wages. | Annual Product. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fourdrinier. | Cylinder. | Washing & Beating. | All. | Men. | Women. | Children. | | Tons. | Value. |
| 812 | $35,500,000 | 299 | 690 | 3,296 | 22,049 | 13,427 | 7,700 | 992 | $9,500,000 | 317,637 | $66,500,000 |

| Classes of Paper. | Tons. | Value. |
|---|---|---|
| Writing paper, rag, | 22,970 | $12,000,000 |
| Book and best printing paper, rag mostly, | 91,446 | 25,000,000 |
| Straw printing paper, | 14,000 | 3,000,000 |
| Manilla paper, | 39,177 | 8,500,000 |
| Straw wrapping paper, | 39,597 | 3,000,000 |
| Wood pulp paper, | 19,700 | 2,000,000 |
| Paper for paper collars, | 3,800 | 13,000,000 |
| Straw and tar boards, roofing, sheathing, building, and paper hangings, | 86,947 | |

In 1875, number of mills, 892; capital, $40,500,000; annual product, 345,000 tons; value about $68,000,000, prices being much lower; proportion of wood pulp paper increased to more than 40,000 tons. Number of hands employed, about 25,000.

*Statistics of* 1880: At the close of 1880, according to the tables of Mr. Howard Lockwood, the highest authority on the subject, there were 959 paper mills, run by 771 firms. At the present time (Sept. 1881) there are very nearly 1,000 mills. The capacity of these mills for production is about 812,000 tons per annum. The actual production does not probably exceed 700,000 tons, and the value of production is between $130,000,000 and $140,000,000. The number of hands employed must be largely a guess. It cannot be less than 30,000, and may be considerably more. 33 states and two territories (Utah and Dist. of Columbia) report paper mills; one, Alabama, having but one, and that not in operation. All the other states and territories, except Missouri, make book and news paper; that state makes only wrapping paper. New York has the largest number of mills, and makes the greatest quantity of paper of all descriptions except writing paper. Massachusetts follows closely, and makes three-fourths of all the writing paper produced in the United States. Pennsylvania, Ohio, and Connecticut are rivals in the amount of their production as well as the number of their mills. After these come in order, New Hampshire, Maine, New Jersey, Illinois, Vermont, Wisconsin, Maryland, Michigan, etc. The capital employed is not far from $75,000,000.

HAND CARDING.

# WOOLLEN MANUFACTURES.

## CHAPTER I.

### WOOLLEN MANUFACTURES—CARDING—WEAVING—FELTING.

The manufacture of woollen, or any other goods, having been prohibited in the colonies under that harsh principle which prompted the Earl of Chatham to exclaim that the "colonists had no right to manufacture so much as a horse-shoe nail," much progress could not have been expected. Nevertheless, progress was made, since the home manufacture of woollen cloth became very general. The people spun and wove their own cloth, and the merchant found little sale for the imported article. The oppressions of the home government were continued, until finally, in 1765, a society was started in New York with great zeal, not only repudiating all foreign goods, but taking measures to encourage the home manufacture of cloth from sheep's wool, and from all other materials. This was very popular; and an agreement was extensively entered into, in order to encourage the growth of wool, to eat no mutton or lamb, and to purchase no meat of any butcher who should kill a sheep or lamb. The economist of the present day will smile at such a mode of encouraging the farmer to keep sheep, viz.: by cutting off his market for the mutton. Nevertheless, it showed zeal. Manufactures are not, however, to be established by resolution. For their development there are necessary, 1st, the supply of skilled labor; 2d, the material for its use; 3d, the capital to employ it; and 4th, the demand for the goods. This latter existed to a considerable extent, on certain conditions, among which was, that it should come within the means of the consumers. There does not appear to have been much scarcity of wool, since home-made goods were generally used. There was an absence, however, of capital, and of that skilled labor which is always the result of extensive experience in the same employment. There came great numbers of artisans from Europe, and it was stated that 30,000 weavers left Ulster in 1774. The war came, peace succeeded, and the new government was formed in 1791; on which occasion, Alexander Hamilton, Secretary of the Treasury, made his famous report on manufactures. He stated, that of woollen goods, hats only had reached maturity, and supplied the demand. At Hartford, a mill for cloths and cassimeres was in operation, and produced excellent wares, under the circumstances; but he remarked, that "it was doubtful if American wool was fit for fine cloths." The quality of wool grown in the country must, since then, have changed very much, since the American wool is used entirely for the fine goods, and the imported wools only are used for carpets and coarse manufactures. The manufacture of cloths did not progress rapidly, since we find that, in 1810, according to the report of the Treasury department, ordered by Congress, the manufacture of wool was still mostly in families. The progress of the manufacture, since that report, has been as follows:—

| | 1810. | 1820. | 1830. | 1840. | 1850. | 1860. | 1870. | 1880. |
|---|---|---|---|---|---|---|---|---|
| Woolen manufacture, | $25,608,788 | 4,413,068 | 14,528,166 | 20,696,699 | 43,542,288 | 61,895,217 | 217,578,824 | 237,587,168 |

This value, in 1810, was nearly all in families, and the figures subsequently are the product of regular manufactures as the business progressed. The family manufacture was necessarily of a rude description. The wool, being washed, was carded between two cards held in the hands of the operator, who continued to card until the wool was formed into a long roll, which was then spun upon the single spindle, driven by the wheel that the busy hand of the housewife kept in motion. There are many still living who were employed in sticking the teeth for those cards, and in tending the wheel. The cloth, woven also by hand, was subsequently sent to mill to be fulled, and dyed, and dressed; which was the first regular business branch of the manufacture. The dyeing was rather an imperfect process. The operator did not then understand the art of fixing colors. Daniel Webster somewhere relates his misfortune, when, dressed up in a new suit of home-spun blue, he accompanied his father on the way to a new school, and, being overtaken by a shower, had the color washed from his new coat into his shirt. With the lapse of time dyeing became better understood. Not many years have elapsed, however, since the distinctive mark of American cloth was, that it wore "white on the edges;" in other words, its color was not fast. With the introduction of machinery, and the improved condition of the people, home manufactures necessarily gave way to machine work. Other occupations paid the time of the farmer better, and the use of machines gradually made a market for the raw wool, at a price which, compared with falling prices of the cloth, would give the wool-grower his cloth without labor. This we may illustrate by extreme figures. Suppose, there being no factories, wool is worth 10 cts. per lb., and cloth imported, $2 per yard, a pound of wool will make two yards, or $4; if not as good cloth, at least good enough. The farmer, by turning his wool into cloth, makes a large saving. Soon, however, machine labor sinks cloth to 50 cts. per yard, and raises wool to 60 cts. The farmer can now no longer afford to make his own cloth, but his wool trade has become profitable. Thus, machine goods supplant hand goods. In this line, the inventions have been very remarkable.

In 1797, Asa Whittemore, of Massachusetts, invented a machine for making cards. Instead of sticking them by hand, as before, a strip of leather, by passing between a cylinder and a scraper, becomes of equal thickness. This strip of leather, in passing through the machine, is stuck full of teeth, that are also made from steel wire by the machine at the same time. The ingenuity of this machine was such, that the famous John Randolph, on inspecting it, exclaimed, that "it operated as if it had a soul!" There have been 100 patents since issued for improvements in this machine. The hand cards were then supplanted by the carding machine. This has a drum of about 3 ft. diameter, and as many long, covered with the cards. Smaller cylinders, also covered with cards, are placed so as to revolve against the circumference of the cylinder, and in the contrary direction. There is a feed apron, on which the wool is laid, and, being drawn in between two rollers, is caught by the cards of the revolving drum, and combed out between it and the smaller cylinders. The wool is thus spread on the surface of all, and is finally taken up by the "doffer," or a cylinder in front of the main drum; from this it flows in a broad, thin, gauzy fleece, which passes through a funnel, and in so doing is contracted into a ribbon, or sliver, which is delivered into a can, ready for the "drawing frame." Long wools and short wools are subjected to different treatment in this stage of the manufacture. The long wools are sometimes called combing wools, in consequence.

In the manufacture of worsted, the long staple is used mostly, because a smooth, fine yarn is required, not much liable to full, or shrink, or curl. In order to form such a thread, the first object is to lay or stretch the fibres into lines, as parallel as possible. If it were possible to procure a single fibre of wool of a length sufficient to weave like a fibre of silk, the beauty and finish of the fabric would be as nearly perfect as could be desired. As that, however, is not possible, the object of the manufacturer is to draw out the fibres into parallel lines, in order that they may twist into a thread as fine and smooth as can be obtained. The old mode of doing this was by hand. When the wool has been washed with lye, or soap and water, and dried, it passes into a machine called the "picker," tended by a boy, who lays the wool as evenly as he can upon the feed apron, which carries the wool between rollers, when it is caught by revolving teeth, torn asunder, and scattered in the air. The fibres are thus cleared and straightened to some extent. They were then taken to the comber, who, in a close room, employed combs with long, heated teeth. The workman oiled the wool, and combed it with these heated instruments, until it became suitable, when it was arranged in "slivers." This was a very laborious and unhealthy task, and many machines have been invented to supersede the hand labor. Some of them are very ingenious, and they have advanced the stage of the manufacture in an eminent degree. When the "slivers" are thus prepared, they are carried to the "breaking machine." There the first sliver is placed upon an apron, which carries it between two rollers, that seize and draw it forward, and it passes from them through other sets of rollers, which move three times as fast. As a consequence, the sliver is drawn out to three times its original length. When it has half passed into the first set of rollers, the end of another sliver is laid upon it, passing thence with it, and becoming incorporated with it in the drawing. All the slivers thus become incorporated in one of three times the aggregate length of all the original slivers, and it is coiled in a can. Three of these cans are carried to the "drawing frame," which has five sets of rollers, operating in the same manner as the breaking frame. As fast as the sliver comes through one set of rollers, it coils into a can, and the slivers of three cans are then united, and pass through another set of rollers. These drawings thus take place 1,500 times with some wool, and the process reduces the sliver to one-fourth its original bulk. There are many variations of the detail of drawing by different machines, but the result is the same. After the drawing is finished, a pound of the sliver is taken and measured, in order to test the accuracy of the drawing. This done, the sliver is passed to the "roving" frame, where two slivers are drawn, as before, into a "roving," which has now become so attenuated, that it must have a twist to hold it together. This twist is imparted to it as it is wound upon spindles, of which the frame contains a great many. The bobbins from the roving frame spindles are then carried to the spinning frame. They are placed upon skewers, and the roving proceeds from them between rollers, of which there are three sets: the first pair turns slowly, the middle twice as fast as the first, and the third from twelve to seventeen times as fast as the first pair. The spindles that receive the thread from the rollers must turn very fast to give the required twist to the thread. The hardest thread is tammy warp, and, when this is of size of twenty-four hanks to the pound, the twist is ten turns to an inch. The least twist is given to thread for fine hose, and it is then five to the inch. The threads are then reeled. The bobbins are placed in a row upon wires, before a long horizontal reel, which is exactly a yard in circumference. When this has revolved eighty times, it rings a bell. It is then stopped, and a thread passed round the eighty turns of each thread. The reel then proceeds. Each of these eighty turns is called a ley; seven such are a "hank:" which is, consequently, 560 yards. When this quantity is reeled, the ends of the threads are tied together, and each hank is weighed by a machine, which denotes the number of hanks to a pound, and this is the number of the yarn: thus, No. 24 means that twenty-four hanks of 560 yards each will weigh 1 lb. A hank of cotton measures 840 yards.

Short wool, for the cloth manufacture, resembles cotton in some respects. The wool being oiled and "picked," is passed through the carding machine, whence it proceeds through the drawing process, as with the long staple, until it assumes the form of yarn for the weaver.

In woollen cloths, cassimeres, broad cloths, narrow cloths, etc., all wool is used: that is, both warp and weft are wool, but the wool is combined with many other articles, according to the dearness of each. The cotton warp is used in satinets; and in most descriptions of dress goods there is a combination of wool with silk or cotton. If these articles are very high, more wool is used; and the reverse, if wool is high, and cotton is cheap, more cotton is introduced into the fabric. There are also a great variety of styles and patterns constantly produced, to attract attention.

The weaving process on the improved power-looms has been greatly facilitated of late years, and the labor has been diminished. Thus, formerly, one person was required to tend one loom, at a certain speed; but, by various improvements, one person may now tend four. In large factories, great numbers of looms are placed in one room, and, as the cloth-rolls become full, they are placed upon a little rail-car, which carries them off to the dyeing and finishing department.

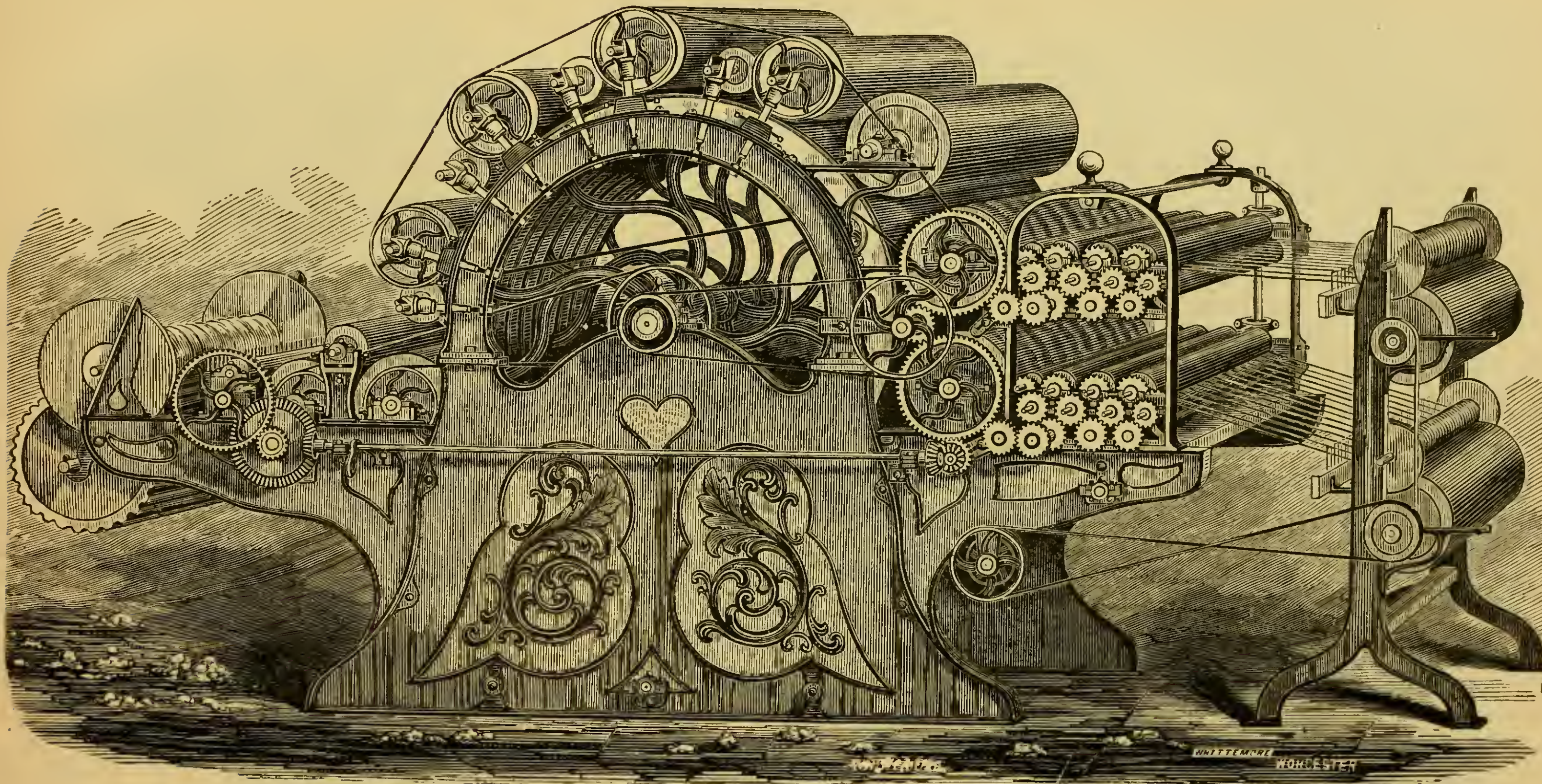
The woven cloth is carried to the fulling-mill, to have the oil applied in spinning, and other greasy matters removed, and, by a partial felting, to give the fabric more compactness. The first process is to scour the cloth. This is done by placing it in troughs, so arranged as to contain the liquids—stale urine and hog's dung, then urine alone, and to be followed by fullers' earth and urine. Heavy oaken mallets, or pounders, slide down with force into one end of the trough, and mash, or roll over the cloths. The pounders are lifted by wooden cams, kept in motion by horse-power for many hours. In this process the oil is detached from the wool, the urine is absorbed by the earth, and both washed off by the water. When this is complete, soap is applied liberally, and the pounding continued, to full the cloth. Instead of soap, in some cases steam is applied, and the pounders made of iron. The process of fulling is also effected without pounders, the cloth being pushed, or squeezed, through a long trough. After the fulling, the soap is washed out, and the cloth is ready for teasling. To full a piece of broadcloth requires sixty to sixty-five hours, and 11lbs. of soap are usually applied. In the process, the cloth will shrink in length from fifty-four to forty yards, and from twelve quarters wide to seven quarters.

When cloth is returned from the fulling-mill, it is stretched upon the tenter frame, and left to dry in the open air. As cloth in the fulling-mill shrinks nearly one-half, it must be woven nearly double its intended breadth. Superfine six-quarter broadcloths are therefore woven twelve quarters wide.

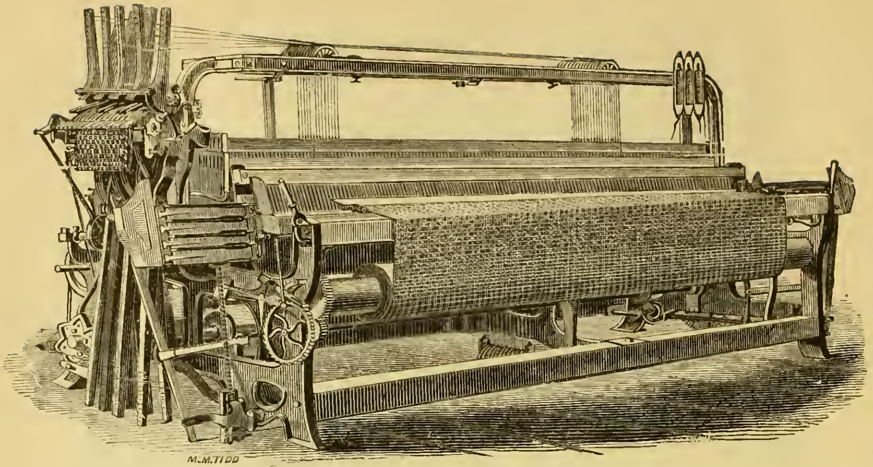
The cloth is minutely examined, when dry, in every part, freed from knots and uneven threads, and repaired, by sewing any little rents, or inserting sound yarns in the place of defective ones.

In order to raise up the loose filaments of woollen yarn into a nap upon one of the surfaces of the cloth, it is scratched with the heads of the teasle plant, or with teasling cards made of wire. In large factories the operation is performed in the gig-mill, which is a cylinder covered all over with teasles, and made to revolve rapidly, while the cloth is drawn over it. This operation requires attention, lest the goods become tender. Indeed, every branch of the wool manufacture requires the supervision of a practical man. If a piece of cloth comes from the press damaged, or inferior, he must be able himself to discover where the fault lies, without taking any other man's word for it; if the wool is not properly cleaned and dyed, the dyer must be called to account, not the carder, or the weaver; and if, through the carelessness of the shearer or gigger, the goods are made tender, they must answer for it, not the spinner. Therefore, the manager of a woollen establishment must be a thorough practical manufacturer, conversant with all the branches of his business, and able to assume and maintain the responsibility of each and every one. This individuality of the manufacturer is well divided among the different branches of the manufacture in England, where the business has grown up in the hands of practical men; but in this country, where manufacturing was, as it were, improvised on the formation of the government, it came, necessarily, under the control of corporations, where the supervising power could not be so well exercised as where each branch is produced by an individual on his own responsibility, and to meet the consequences of defect himself. In a corporation, many of the appointments are independent of the general direction, and the resulting defects in fabrics are placed to the account of the wrong party, or not fixed upon any.

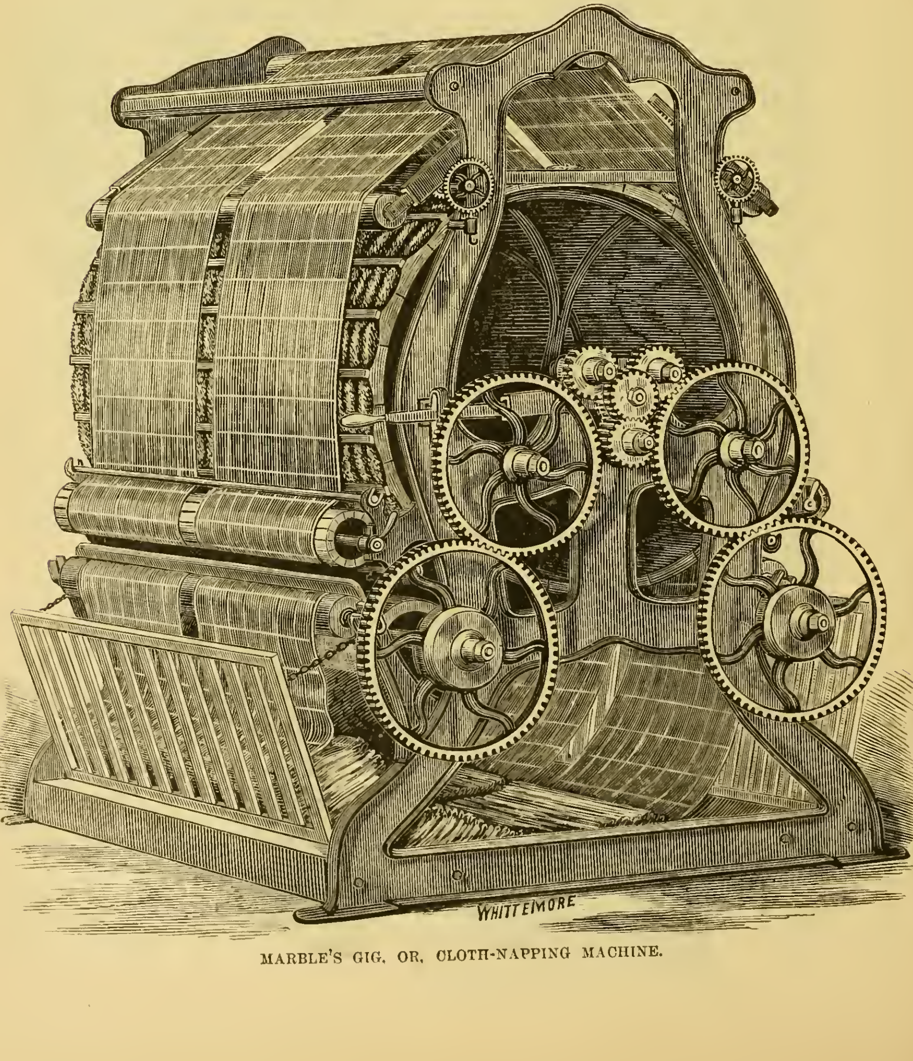
The art of dyeing and printing fabrics is one of the most progressive connected with manufacturing. The materials of human clothing are mostly from silk and wool, of animal origin, and cotton and flax, of vegetable origin. These two classes differ in the facility with which they imbibe coloring matter. The animal fibre takes much more brilliant shades than the vegetable, and the color may be applied to either class in the raw state, in the spun yarn, or in the fabric: hence, great diversity in the processes. The coloring matters are themselves of the most various origins—animal, vegetable, and mineral—and their substances, brought together, act upon each other, and produce the most intricate changes. The leading vegetable colors are yellow, brown, and red; blue is derived only from litmus and indigo; black is afforded by nutgalls, sumach, and cashew nut. These are generally obtained by water; but some of the substances require either alcohol or some of the fixed oils. From the animal kingdom come, from the bodies of the cochineal and kermes insects, the brilliant scarlet and crimson dyes. The ancient dye, called Tyrian purple, was long supposed to be lost; but a French chemist has lately discovered it. Hoofs, horns, etc., give Prussian blue. Many brilliant colors are derived from the salts of various metals. The same metal is caused to give various colors. Iron gives that buff known as nankeen; it gives various shades of blue, and is made to yield black, slate color, and other shades. Chrome, and lead salts, give an interesting variety of colors. The materials to be dyed, of what-




IRON FRAME FINISHER CARD MACHINE.




CROMPTON IMPROVED FANCY LOOM.




MARBLE'S GIG, OR, CLOTH-NAPPING MACHINE.

ever nature, are seldom found to have such an affinity for the dyes used that they will retain them. They will soon wash out, unless a remedy is applied. Chemistry discovered this in certain substances that will fix themselves permanently upon the fibre, and then, by uniting chemically with the color, "fix" that permanently also. These applications are called "mordants," from the Latin, *mordeo*, because they were thought to bite into the fibre. It is sometimes the case that, in thus combining with the color, the mordant will modify or alter its tone, and those having this effect, are sometimes called "alterants."

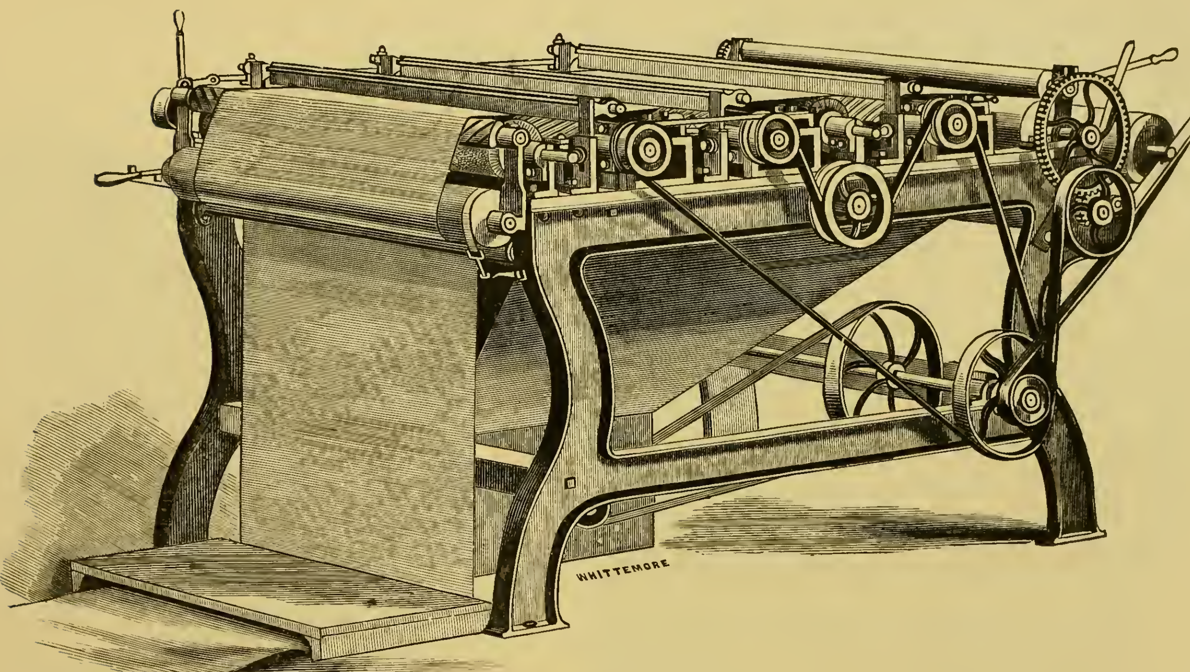
Thus, if a decoction of madder be applied directly to cloth, it gives a dirty red color, that will not remain. If the cloth is first prepared with acetate of alumina, the color will not only become entirely fast, but will assume a fine red hue, which will resist the action of air, light, and water. If, instead of the alumina, oxide of iron is used as a mordant, a purple color will be obtained. In dyeing with cochineal, if crimson is required, alumina is used for a mordant; if oxide of iron is used, the color will be black. It follows, that mixing mordants will multiply shades, and the variations of proportions and strength of solution give a wide field for the production of effects. It sometimes is the case, that two solutions, neither of which will give any color at all to the fabric, will impart a fast color by following each other in the application. Thus, a solution of nitrate of potash gives no color to cloth, and may be washed out; the same is true of bichromate of potash; but if one of these is applied after the cloth has received the other, a fast yellow is obtained. In the process of mandarining, an acid is made to act directly upon the fibre of the wool. In a large factory, the dye stuffs are ground and mixed in an appropriate room. The infusions are made in tubs or vats, some in cold water, and others in boiling water. Some of the dyes are introduced in the shape of a coarse powder, and others in bags, through which the color oozes. The cloth is first prepared by thorough cleansing, in order to remove all extraneous matters that may be attached to the fibre. When this is completed, the mordant is applied by soaking the cloth in appropriate solutions. It is then hung up to dry in long folds, if intended for printing, as in the case of muslin-delaines, a fabric in which the American manufacturer has come to surpass the imported article, and to monopolize the market.

The art of printing goods may be said to have been created in the last fifty years. As practised in the early part of the century, it was comparatively rude. The figures to be impressed upon the cloth were engraved upon a square block of wood, and the color being applied to this, it was impressed upon the cloth, which was then drawn forward, and a new application of the block made. This was the style of printing practised originally by Robert Peel, grandfather of the late prime minister of England, and founder of that family. An improvement was then made by engraving the pattern upon a copper cylinder, and by passing the cloth over this, the work was done with more precision and continuity. This was costly, however; and one such cylinder laboriously engraved, would print only 1,500 pieces of cloth. Perkins, of Newburyport, Massachusetts, then invented the die. This is a small steel roller, on which the figure is engraved, and made exceedingly hard. From this, the figure is conveyed to a soft steel roller by pressure. From this last the design is impressed upon a copper roller by pressure. This last prints the cloth. In this manner, the design on the steel die, once engraved, may be multiplied to any number. The original block-printing would take but one color. Numbers of improvements were made to increase the number of colors that might be printed. This is now done by engraving the dies and rollers with portions of the designs that are to take different colors. The rollers are placed upon the printing machine in such a manner, that the cloth passes up slowly over the large drum of the machine. They each, in succession, impress it with the design and color with which they are fed. Almost any number of colors may thus be printed. The style and quality of ladies' dress goods of wool, have thus made rapid strides in the last few years.

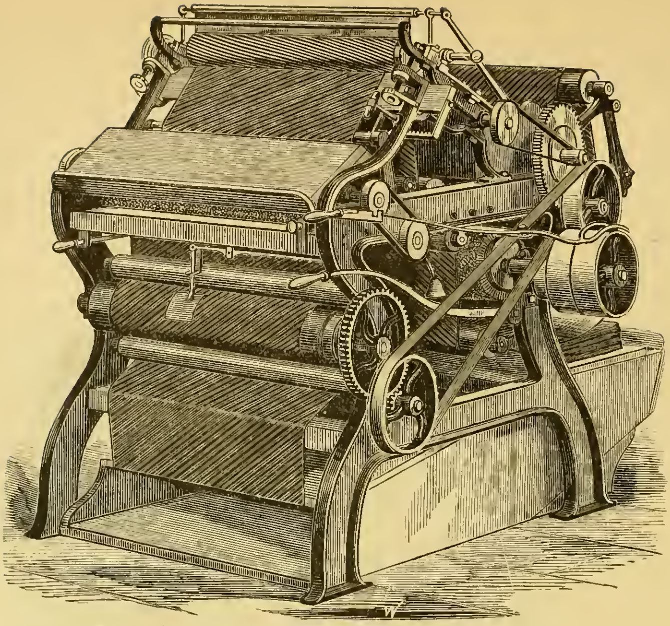
The faculty of felting possessed by the wool, arises from the barbs upon each fibre, like those that are to be seen on each fibre of a feather, locking into each other. The process of rubbing in hot water causes those in the wool to become more closely interlocked, until the whole becomes a compact mass.

The making of hats of wool was a large business in the New England colonies early in the 18th century—so much so, as to draw upon them the interference of the government for the suppression of the business. It continued, however, locally, and was, in 1791, mentioned by the Secretary of the Treasury as one of the most successful. The manufacturing process was mostly the same, although the form of the hat underwent many changes, from the "cocked" to the "stovepipe," and latterly to "Kossuth," "Derby," and other styles. The wool—mostly lambs or short wool—was washed in urine to remove all grease that prevented felting. The wool then, being dried, was "bowed." This was performed by the operative, who laid about 3 oz. of wool upon a board, and then, holding in his left hand a bow with a stiff string, he vibrated the string in such a manner as to strike the wool, and cause it to fly out clear and loose. When quite clear, it was formed by hand into a cone form nearly three times as large as the proposed hat body. To keep the light wool together, it was placed between two cloths. It was then immersed in water, and continually rolled in different directions upon a short round stick held in the hands of the operator. This operation caused the hat to felt or shrink into the proper size and shape. Being then in the sugar-loaf form, it was stretched upon the hat block that gave it its shape, and the manufacture proceeded with, until, napped with fur and trimmed, it was ready for sale. About 30 years since, machines for forming the bodies were introduced, and these soon supplanted the old hand system. The wool was washed with soft soap as a substitute for urine, the lye of the soap being equally efficacious in removing the grease. When dry and clean, the wool was passed through the "picker," made with a cylinder covered with long teeth. As this revolved with great velocity, it took from a pair of rollers the wool, separated it, straightening the fibres, and cleaning it of dust at the same time. This wool was then passed through the breaker, or carding machine, as in preparation for spinning; but as the broad fleece comes off the doffer, instead of being drawn into a ribbon, it is received upon a pair of light wood cones, placed with their bases together. To these a vibratory motion is given at the same time that they revolve. The result is, that the fleece of wool winds over them in contrary directions, until they appear like a large cocoon. When about 3 oz. are wound upon the cones, the boy who tends cuts them apart with shears, and by a rapid movement removes the woolly cap from the cone, which instantly resumes its motion. These caps, so removed, are perfectly formed "bodies," ready to be felted in the usual manner. The regularity and rapidity of the formation enables a "body" to be formed with much less wool than by the hand system. Instead of 3 to 4 ozs. for a hat, a perfect body was now formed of 1 oz. weight. This process of the wool manufacture grew rapidly, until a machine was invented to form hat bodies of fur. The difficulty in that respect had been that the fur could not be carded into a fleece like the wool. A machine was then invented, by which the air was exhausted under a fine wire gauze, and the fur flying was drawn upon this and partly felted into a ribbon, which was wound upon cones for the hat bodies. The next process was to form the cone itself full of holes, and, by exhausting the air, the fur is caused to settle upon it evenly, in weight sufficient for a body. These fur hats caused those of wool to rank second.

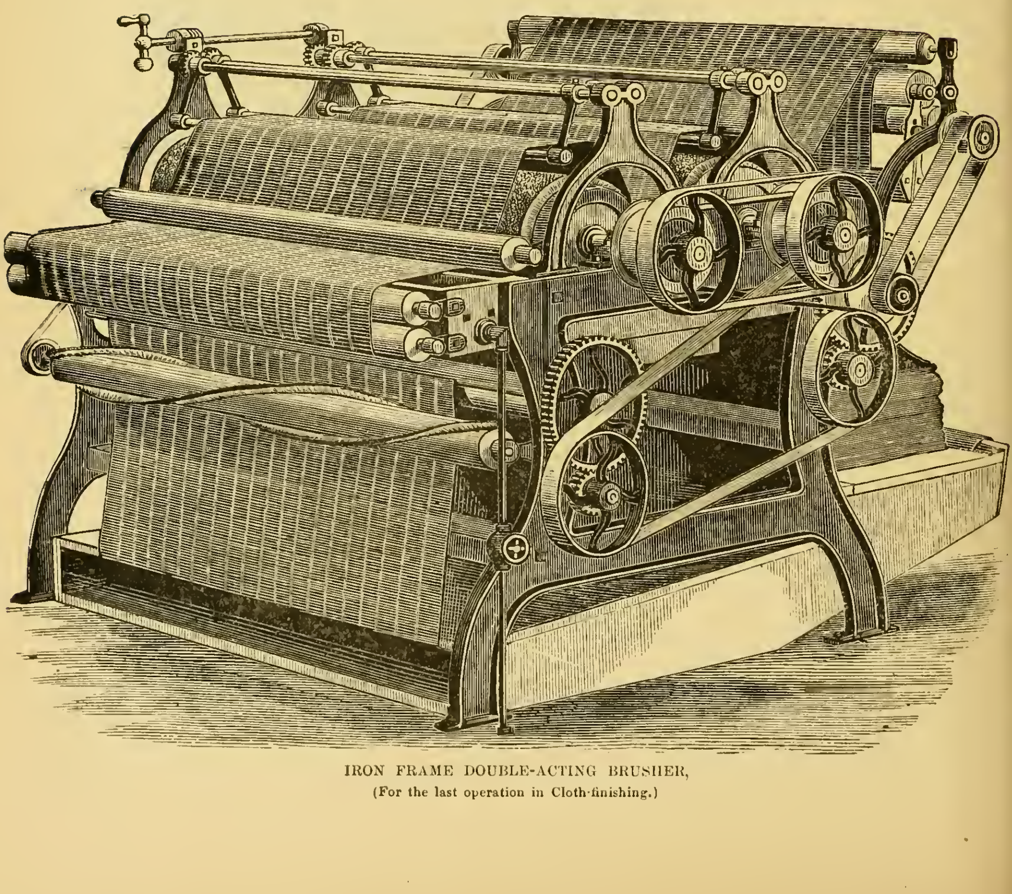
The felting qualities of wool have, however, caused it to be used for many other purposes, such as piano-covers, drugget, and for the manufacture of cloth without weaving. This is called beaver cloth, and is difficult to detect, by the eye, from woven cloth. Several manufactories of this description are in operation in Connecticut. The wool being worked and "picked," is carded in a machine which is double the width of the ordinary one, in order to deliver a fleece or web six feet wide instead of three. This "web" is, as it is delivered by the machine, carried out, in a horizontal direction, 21 feet, and so doubled in folds until it gets a proper thickness for felting. Inasmuch as the process of felting causes a web to contract more in breadth than in length, it becomes necessary, to give the cloth a proper consistency, that the webs should cross. To do this two machines are placed at right angles with each other, and as the web of one is extended, that of the other crosses it. When the proper thickness is thus attained, the whole is rolled upon a beam, and transferred to the felting table. Here a number of cloths are laid together upon an endless apron, the movement of which carries them forward over an iron plate, perforated with holes, through which steam ascends, and thoroughly heats and saturates the cloths, which proceed under a platen, to which steam power imparts a rapid vibratory mo-




COTTON-SHEARING MACHINE,
(For Shearing Cotton Prints, Tickings, Drillings, Denims, &c.)



MARBLE'S IMPROVED PERPETUAL SHEARING MACHINE,
(For Woolen Goods.)



IRON FRAME DOUBLE-ACTING BRUSHER,
(For the last operation in Cloth-finishing.)

tion, which felts the cloth. When this is completed, the cloth is dyed of the requisite color, and then subjected to the fulling and teasling process, like a woven cloth. For those heavy coat cloths that are in the style called Petershams, another process is substituted. It consists in passing the cloth under a sort of press, of which the lower side, on which the cloth rests, is stationary, and the upper, being covered with sand, receives a rapid, rotatory, vibratory motion, which rolls up the nap into those little knots that are the distinctive feature of Petersham. The nature of these cloths permits of giving them two colors. Thus a dark and a drab color may be felted together to form one cloth, of which the inside is of a different color from the outside. These cloths are used to some extent by the clothiers, but their durability is said not to be such as to recommend them.

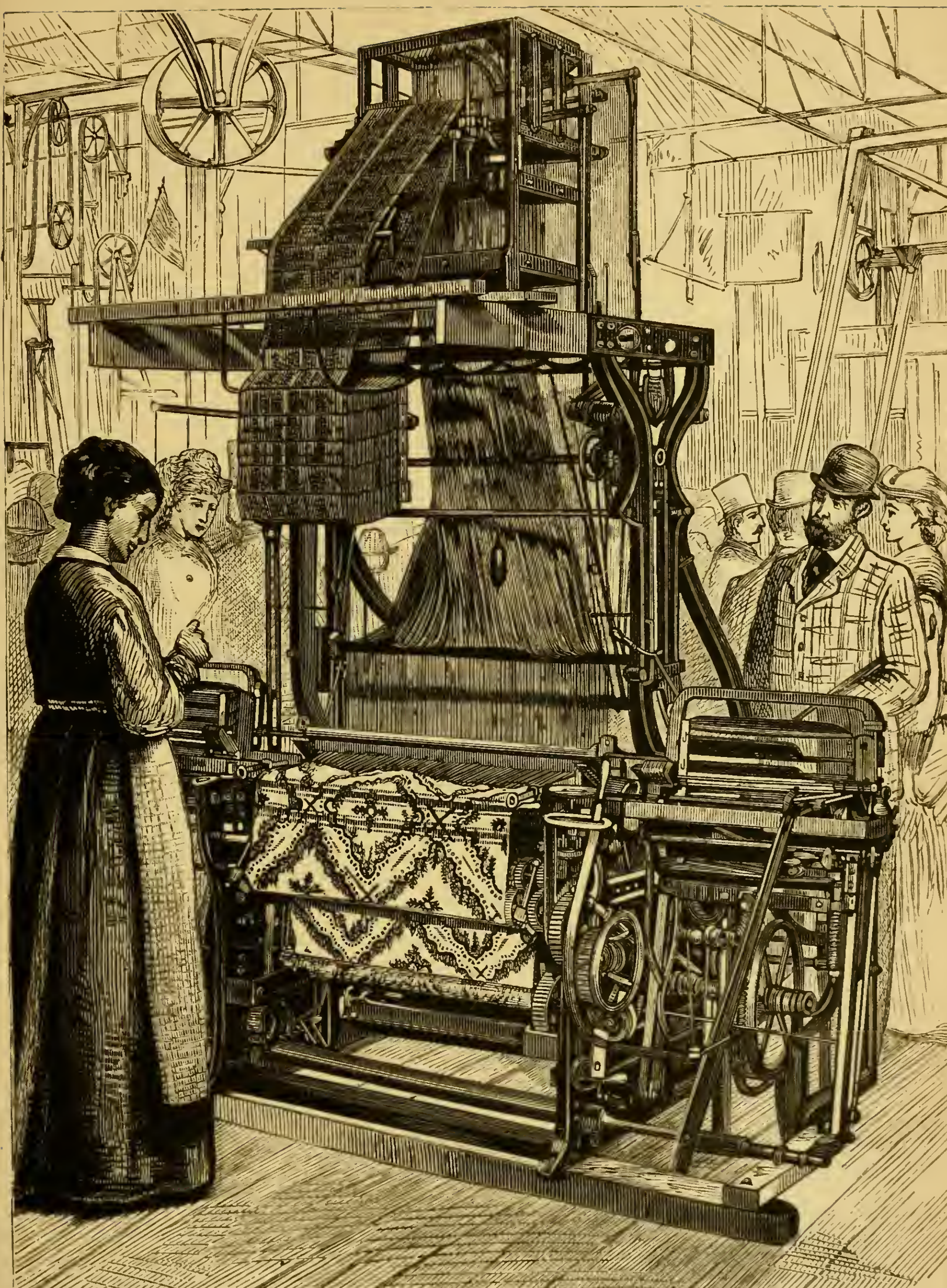
Of all people, the American shows the most remarkable inclination for good carpets. It seems to be impossible for him to walk comfortably through life without a carpet under his feet. Every man who occupies a few square feet of house-room must have the brick or the boards protected from his tread by so much carpeting. Here carpeting appears in a thousand places where, in other parts of the world, it is never seen. The English shopkeeper thinks the bare boards good enough for the reception of his customers, and seldom does the merchant think of adding to the elegance of his counting-room by laying down a square of Brussels. Only those churches devoted to the service of the more aristocratic worshippers, are furnished with the comforts of Kidderminster—the bare wood, or bricks, or stone, being considered more consonant with "the self-denying duties of the sanctuary." Widely different is it with the well-to-do American. He believes in enjoying life; and considering that carpets contribute to life's enjoyment, he does not hesitate to spread every place where he is accustomed to tread with a covering of three-ply, tapestry, Brussels, Moquette, or Axminster. The number of yards, of all descriptions, imported, per year, averages, for the five years, 1876–1880, 726,351 yards—less than one half what it was in 1850, and our exports average 20,000 yards. Our manufacture of carpets in 1870 amounted to 21,485,233 yards, or more than 30 times our present importation, and within the last decade it has increased with wonderful strides, amounting, according to the bulletins of the census office, in 1880, to yards. The carpets most in use in this country are known as "rag carpets," as ingrain, super two-ply, three-ply, Venetian, tapestries, Brussels, velvets, Wilton, Turkey, Axminster, Persian, Aubusson, and Moquettes. The ingrain carpet is made with two sets of worsted warp, and two sets of woollen weft. It consists of two distinct webs, incorporated into each other by the warp, threads passing from one to the other to bring the required colors to the surface. Each web is, however, a cloth of itself, which, if separated by cutting from the other, would present a coarse surface, like baize. Two colors only are used with effect in this kind of carpet. The three-ply is similar, but produced by three webs, making a thicker carpet with a greater number of colors. The pattern in this does not appear in opposite colors, as in the two-ply. This fabric was long thought not adapted to power looms, but in 1839 Mr. Bigelow, of Lowell, improved these looms, so that weavers who were then making 8 yards per day by hand could make 12 yards per day by power. This plan has since been so improved that power looms are now wholly used, with such economy of labor as greatly to reduce the cost of carpets. The judgment and skill of the weaver was a great element in the production of the goods.

Mr. Bigelow, in his first loom, contrived to take up the woven cloth by an unerring motion, the same amount for every beat of the lathe. His next step was to regulate the tension of the threads, so as to keep the selvage smooth, and the figure regular. In this he succeeded so as to bring the two-ply loom to 27 yards per day, and the three-ply loom to 18 yards. His method of producing figures that will match was patented in 1845. The same machine was found to be applicable to Brussels and tapestry carpets, the weaving of which by power was before thought to be impracticable. They were made at the rate of 4 yards per day by hand. This has been increased to 20 yards per day by the new process. The figures of the carpets are also made so as to match perfectly, and surpass the best carpets made in any other part of the world.

These looms are used in factories built for them in Lowell and Clinton, Massachusetts; Thompsonville and Tariffville, Connecticut; Auburn and Yonkers, N. Y.; there are three large factories in New York, as many in Philadelphia, and a number in other towns and cities. The Brussels carpet is made upon a ground of linen weft, which is concealed by the worsted threads that interlace and cover it. The threads are of two, three, four, or five different colors, and, each being brought up to its place by a "frame," the fabric is called two, three, four, or five-frame Brussels. In weaving, these run the length of the web, and are so managed that all those required by the pattern are brought up together across the line of the carpet. Before they are let down, a wooden instrument called a sword is passed through, to hold up the threads. This is replaced by a wound wire, which being at last removed leaves a row of loops across the carpet. In a yard there are sometimes 320 successive lifts of the sets of colors required, each of which forms a row of the loops. The Wilton carpet differs from Brussels in that the loops are cut before the wire is removed. A groove runs in the wire to receive the edge of the cutting knife. The soft ends of the cut loops give the carpet its velvet appearance. In Imperial Brussels, the loops of the figures only are cut. Here a new invention was brought into use to make "tapestry and velvet pile." This is a combination of the arts of printing and weaving. The principle is this: if a rosebud occurs a thousand times in the length of a web, at 4 feet apart, the block-printer must apply his block a thousand times to print the bud. By the new process the thread is wound a thousand times round a cylinder 4 feet in circumference, and a turning wheel charged with color passes across the coil. The thread unwound is found to be marked in a thousand places exactly where it is wanted. The threads are thus all parti-colored, and singly show no regular figure; but when arranged in the proper order for the weaver's beam, the figures come into view much elongated. Sometimes 18 feet of warp will be gathered into 4 feet of cloth, in order to secure the due proportion of the intended object. By this system the number of colors, that could not exceed 6 or 7 by the old plan, is now increased to 20 or 30, or any number; and instead of a change of blocks for every pattern, the same blocks serve for all patterns. Aubusson, Moquette, and Axminster are very similar in appearance and construction. They are made with a high tufted pile, thick, durable, and expensive. They are constructed with a firm groundwork of linen or cotton, upon which is woven the body of the fabric—the warp and woof, to which the tufts supplied from a series of rollers corresponding in number to the picks or wefts, completing one pattern and of a length equal to the width of the carpet are attached. As these tufts are of soft woolen yarn and form a surface altogether independent of the body of the carpet below, the employment of an almost unlimited number of colors is admissible, and the designs in these grades are therefore generally of the most perfect and elegant description. It is only within the past ten or fifteen years that American manufacturers have succeeded in surmounting the difficulties attending the production of these goods; but the American goods are now fully equal to the imported.

The wool used for the manufacture of carpets comes from Russia, near the Black Sea, from Turkey (Smyrna), from the East Indies, from Cordova, Buenos Ayres, Monte Video, and Valparaiso, S. America; from Texas, New Mexico, and Arizona, and some from Mexico. The Combing Donskoi (a Russian wool, washed fleece) and the Smyrna, also washed, bring the highest price, from 23 to 25 cents a pound, E. India white, washed, from 16 to 18, the South American wools, not washed, from 14 to 15, and our own South Western, not washed, about the same. If these wools have not been washed or scoured, they are first put through that process, and then sent to the combing machine to be separated into long and short-fiber wools.

The long are passed through rollers, and assume a form entitled a "sliver," which is allowed to fall into a hollow cylinder set for the purpose, while the short fibers disappear in a mysterious-looking box at one side of the room. These slivers are then passed through a drawing frame, twenty or more of them united, and drawn out so as to equalize the thread; eight or ten of these threads are again subjected to the drawing process and reduced to one, which operation is repeated as often as is necessary to produce uniformity. These long



THE MURKLAND INGRAIN CARPET LOOM.

fibers, so carefully put through this process, are intended to form the warp of the carpets, while the short fibers are used for the "woof" or "filling." In the spinning-room, both staples of wool come together to be spun on the long, clashing, clattering "spinning jacks," twelve in number, some of them spinning 256 and others 308 threads at once. When it leaves the "jacks" it is in the form of coarse yarn, tightly rolled on large spools, from which it is wound into skeins and is ready for the dye house. By a curious system of folding, of a recent American invention, part of the yarn skeins are, after being scoured (a process applied to all yarns to free them from their natural oil) subjected to a parti-colored dyeing—and thus the same skein, or frame of skeins, may sometimes bear half a dozen different colors. These parti-colored yarns are used for warp. Other bundles of yarn are submerged in rolling, steaming floods of colored liquids of every hue. That portion intended to be used white is bleached by means of sulphur in houses erected for the purpose on the river bank. From the dyeing-room, the yarn is conveyed to the drying-room, immediately over the engine boilers, and after it has become thoroughly dried is conveyed to the winding room, where winding machines, worked by girls, are at work, filling spools and bobbins from the skeins; and no sooner are the spools filled than they are unfilled by the warping machines, five of which are constantly in operation. The threads are here wound upon the large cylinders for the printers, and each filling of this great cylinder makes but a single thread in the warp of a single pattern, so that for a piece having 208 threads in its width, the cylinder must be filled and carefully printed a corresponding number of times. These monster skeins, after being printed, sometimes with 100 or more shades of colors, each laid on in straight lines by a small printing roller, traveling across beneath the large cylinder, are packed at full length in rice chaff, and having been placed in boxes on a little railroad car, are shoved into a boiler, where from 4 to 6 lbs. pressure of steam is applied. When the colors have been thoroughly fixed by this means, the skeins are dried and passed through what are termed setting machines, when the yarn is ready for the Bigelow loom. These have on the end of each of the little wires used

CARPETS OTHER THAN RAG, MANUFACTURED IN THE UNITED STATES IN 1860, 1870, AND 1880.

| Items. | 1860. | | | | | 1870. | | | | | 1880. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Penn. | N. York. | Mass. | Conn. | U. S. | Penn. | N. York. | Mass. | Conn. | U. S. | Penn. | N. York. | Mass. | Conn. | U. S. |
| Number of Establishments, | 137 | 28 | 11 | 3 | 213 | 184 | 13 | [illegible] | 3 | 215 | 240 | 16 | 13 | 5 | 284 |
| Hands Employed,......... | 2,396 | 1,903 | 1,361 | 701 | 6,681 | 4,941 | 3,424 | 2,20[illegible] | 1,185 | 12,098 | | | | | |
| Capital Invested,.......... | $872,200 | $1,017,868 | $1,981,900 | $700,500 | $4,721,768 | $3,026,500 | $4,251,750 | $3,250,00[illegible] | $1,530,000 | $12,540,750 | | | | | |
| Wages,............... .... | $606,060 | 358,980 | 334,184 | 179,304 | 1,545,692 | 1,870,527 | 1,423,784 | 832,954 | 432,031 | 4,681,718 | | | | | |
| Cost of Raw Material,..... | $1,247,059 | 886,502 | 1,530,903 | 614,510 | 4,417,986 | 5,619,448 | 3,046,863 | 3,256,628 | 1,307,397 | 13,577,993 | | | | | |
| Quantity of Annual Product. Yds............ | 5,931,460 | 2,293,514 | 3,235,553 | 1,440,000 | 13,285,921 | 12,257,712 | 4,425,288 | 3,521,560 | 1,710,550 | 21,985,233 | 20,500,000 | 5,100,000 | 3,900,000 | 1,850,000 | 31,500,000 |
| Value of Annual Product,. | $2,710,092 | $1,627,960 | $2,358,278 | $893,100 | $7,857,636 | $9,758,171 | $4,976,835 | $4,487,525 | $2,027,136 | $21,761,573 | | | | | |

to raise the pile of the Brussels carpet a small knife, which, while it weaves, cuts the pile and makes it "velvet." The next machines to which the fabric is subjected are for shaving the velvet, and girls are employed in trimming the under side of the goods and preparing them for the rolling machine. Here the carpets are rolled, marked with the number of the pattern of each roll, number of yards, etc., and thus prepared for removal to the warehouse. The lengths of the pieces usually are: velvets, from 40 to 50 yards; tapestries, 50 to 60 yards; and ingrains, from 100 to 110 yards.

The manufacture of long shawls, for men's use, was pushed to a great extent a few years since. The Bay State Mills became famous for these shawls, and used for them 3,000,000 lbs. of wool per annum.

The production of hosiery and fancy knit work has become very important in the last twenty or twenty-five years. The supply of these articles came formerly from England, but of late the manufacture of these articles has received a great development, particularly in Philadelphia. The fine American wool is well adapted to the manufacture. The business is largely carried on in families as well as in hundreds of factories. There are eight or ten knitting machines, all of American invention, which have rendered the business of knitting wool goods of all kinds almost a pastime. They are mostly automatic and fashion every description of knit goods perfectly, and so rapidly as to reduce the cost almost to nothing. The Nelson machine completes a pair of stockings at a cost for labor of only a sixth of a mill a pair. Other machines make other kinds of knit goods. Zephyr worsted is used in much of this work and the demand for that yarn causes frauds to enter into the sale. Each pound of zephyr is divided into 16 laps, which are sold without weighing, as containing each one ounce of wool. Full weight would be 16 drachms to the ounce lap, or if stored in over dry atmosphere, 15¾ drachms; but the fraud consists in putting up only 15, 14, 12, or 10 drachms in each ounce lap, the number of laps in a pound being the correct number—16. These frauds are difficult to detect, as the dishonest dealer is provided with false weights, which make his goods appear on trial to be correct. The ounce of the apothecary shops contains more grains than the true standard avoirdupois ounce, so that it cannot be tested there. The proper remedy would be to inquire continually of dealers whether their goods are full weight or short weight, to show that public attention is directed to the matter, and to compare articles bought at different stores, by putting them on the opposite scales of a balance, and noticing where goods are sold by true or best weight.

## CHAPTER II.

### CLOTHING TRADE—TOTAL MANUFACTURE—SHODDY.

Until within the last forty-five years, the ready-made clothing trade was confined almost entirely to the furnishing of sailors' sea fit-outs. The stores for this purpose were mostly kept by sailor landlords, whose business philanthropy led them to coax "poor Jack" into their "cribs" on his arrival, and feast him high while his earnings lasted; and as soon as these were gone, ship him on board some vessel, obtain his advance pay, varying from $12 to $20, according to the demand for seamen. If this is not all due the landlord, he supplied slops at enormous rates for the balance, got Jack dead drunk, and put him on board at the last moment in that condition. In such a business, ready-made clothing was indispensable, but otherwise there was little market for made-up goods. Most families in the country made their own clothes. But as taste and wealth improved, the difficulty of "cutting out" called into being a special trade, and most villages and towns in the country were visited by professional persons, who boarded round in the families where cutting and fitting, as well for males as females, was in requisition. Another trade also grew up in the cities; it was the dealing in second-hand clothing, mostly by Jews. These industrious persons bought up all the old clothing that could be had, cleaned, repaired, and redressed them, and sold them to those who sought to economize. The cleaning and repairing of these clothes occupied great numbers of poor people. The repairing soon grew into fabricating very cheap cloths bought at auction, "half-burnt," "wet goods," etc., to sell them in connection with the old garments. Visitors from the country found that garments could be bought in this way to better advantage than even to have them made at home, and the boarding-round system began to wane. It was soon found in New York that the great crowd of visitors who passed rapidly through the city, and had little time to wait for measures, or to be inconvenienced with tailors' delays and misfits, would become buyers of a better class of ready-made clothing, and the manufacture began to spread by tailors keeping assortments, and in 1834 and 1835 the wholesale manufacture commenced in New York. One of the first of these, a shrewd judge of cloth and a close reckoner, commenced with little capital, slept under his counter, and kept his personal expenses very small, devoting his whole time to the cheap purchase of cloth, and the most economical way of making it up. This trade grew rapidly to an expenditure of $80,000 per annum for labor, mostly to sewing girls, at ridiculously low prices. It was obvious that where the purchase of goods, the cutting, and making are attended to by experienced men, on a large scale, the cost of the goods would be very much less than that at which individuals could get them up. There were many in the trade when the revulsion of 1837 ruined them. The trade was soon again re-established, and it has continued to increase, not only in New York, but has spread into all the cities of the Union. The census of 1870 gave the clothing business for both sexes as follows:—

| | |
|---|---|
| Number | 9,685 |
| Capital | $53,417,298 |
| Cost of material | $92,935,209 |
| Males employed | 48,039 |
| Females employed | 70,336 |
| Cost of labor | $33,048,835 |
| Value produced | $160,550,961 |

The decade 1870–1880 has been marked by a great increase in the clothing trade. All the large dealers in dry goods are engaged in the manufacture and sale of under-clothing to the extent of tens of hundreds of thousands of dollars, and most of them also in women's clothing in similar amounts. The purchases of the clothiers, a distinct feature in the goods markets, take place many months before the goods are sold. The cloths for winter goods are bought in the previous spring, in order to give time for the making up. In a large clothing establishment the business proceeds with great method. The cloth, as soon as it comes in, is subjected to a rigid scrutiny, and blemished portions are removed. The piece is then taken to the superintendent, a statement of the number of yards, the cost, and of whom purchased, is then entered in a book kept for the purpose. There is also entered the number and description of the goods to be made, how they are to be trimmed, the name of the cutter, the price of making, etc. The cloth is then transferred to the cutter, with directions as to kind of garment, style of cut, sizes, etc. The garments being cut, are passed to the trimmer, who supplies buttons, thread, lining, etc. The goods then come under the control of the foremen, of whom there are several, and these give them out to be made. The number who do this part of the business is very large, and are mostly females. They take home pantaloons, vests, etc., and when not well known to the foreman, are required to leave a deposit in money for the return of the goods. This is necessary in large cities, since it happens that if there is no deposit, the person may be tempted to pawn or sell the goods; or, if she is honest, she may have a drunken husband, who will seize and pawn the goods. It often happens, however, that poor, deserving women have no money to deposit, and go hungry in face of work that they might do. There are, on the other hand, knavish dealers, who, taking advantage of the position of the depositor, require it, and when the goods are returned, declare the work ill done, and retain the deposit to pay for the alleged spoiling of the cloth. There are also great numbers of men employed in doing the heavy work, and since the introduction of sewing machines, these have been largely used. Among the numerous immigrants into New York, are many German and other families, who take in sewing, and these nearly all have a sewing machine. This demand for the machines is supplied by the liberality of the competing patentees. They deliver a machine upon the payment of a small sum, and allow the buyer to pay up three to five dollars a month until the purchase is completed. In this manner the supply of labor in the manufacture of clothing is greatly increased, but the pressure is harder upon those who have no machines. The women may, however, earn from $6 to $12 per week; the former price on coarse work was as low as 25 to 37½ cents for common silk vests, and as much for pantaloons, of which two pair a day is a large production. For custom-made silk vests, $2 is paid. The finer coats are made by regular tailors, employed in fashionable city shops during the dull season, and these earn $14 to $20 per week. The supply of labor is not, however, confined to the city, but embraces a broad circle of country, to which goods are sent by rail and express to be made up. Many clothing concerns have agencies in the country towns. These keep vehicles to travel round to farmers' and other dwellings where good sewing is done in the winter, with his goods, and bring them back when done. This reverses the old system of boarding round to cut out family goods, since the goods go round to get made up.

The cutting is an "art" of itself, and requires a certain talent. It is, in fact, the most important part of the manufacturing, since the style and "set" of the goods depend upon it. The large New York clothing stores employ the best "talent" in this line.

The manufacture of women's clothing, dresses, suits, cloaks, waterproof and repellent garments, &c., &c., has sprung up almost entirely since 1860; and since that time also the manufacture of under-clothing for both sexes has become a business of great magnitude. In 1850 and perhaps earlier, the production of men's fine shirts had attained considerable magnitude, but all other under-clothing for both sexes is at least ten years later.

The clothing trade of Boston has also received a great development of late years, and by a combination of circumstances which have had their influence everywhere. In 1840 there were only two houses in the trade in Boston, and the aggregate sales were about $200,000. The supply of cloths, &c., is large in Boston—as well from the manufacturers direct, as through commission houses who advance on them to the manufacturers. The cutting is done in Boston, but the sewing mostly in the farmer's families throughout New England, and about 60,000 females in such situations are employed. The numerous railroads that traverse the country, make commodities cheap; and as sewing machines improve in the quality of the work they do, and in the cheapness with which they can be furnished, hardly a house is without one, and all seek employment for them. In 1857, when the financial pressure caused so many mills to stop, throwing hands out of employment, these sought sewing as a substitute; and their savings enabled them to buy machines. The same event threw large quantities of goods upon the market, through the auction houses, and also through the hands of the commission houses, to whom the manufacturers pledged them for money. Thus, there was a large supply of goods and labor at less than former rates; clothing could be furnished much cheaper, and this circumstance was not advantageous to the old stocks. That circumstance gave an impulse to the clothing business, as bringing more within its scope.

The following table gives the most complete history of the progress of woolen manufactures, importation of woolen goods and raw wool, and the production of wool in this country at each decade of the last forty years which has ever been attempted. For many of the items in it we are indebted to John S. Hayes, Esq., LL.D., the able and learned Secretary of the National Association of Wool Manufacturers, and to Geo. Wm. Bond, Esq., the special agent of the Census Bureau on Wool Manufactures:

STATISTICS OF WOOL MANUFACTURE AND IMPORTATION, 1840-1880.

| Census Years. | Number of Establishments. | Hands Employed. | | Capital Invested. | Wages Paid. | Pounds of Wool Consumed. | Value of Raw Material. | No. of Spindles. | No. of Sets of Cards. | Value of Annual Product. | Annual Importation of Manufactured Woolen Goods. | Annual Importation of Raw Wool, Shoddy, &c. Values. | Annual Importation of Raw Wool, Shoddy, etc. Quantities. | Wool Production in Census Years.‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Males. | Females. | | | lbs. | | | | | | | lbs. | lbs. |
| 1840 | 4,005* | 21,432 | | $15,765,124 | | 50,808,524 | | | | $20,696,699 | $11,001,939 | $1,091,953 | 15,006,410 | 35,802,114 |
| 1850 | 2,447 | 22,678 | 16,574 | 28,056,220 | | 67,762,829 | $25,755,938 | | | 43,542,288 | 17,151,509 | 1,690,380 | 18,695,294 | 52,516,969 |
| 1860 | 1,975 | 24,841 | 16,519 | 30,862,654 | $9,808,254 | 83,608,468 | 36,586,887 | | 3,209 | 61,895,217 | 37,876,945 | 4,843,385 | 28,509,211 | 60,511,343 |
| 1870 | 3,041 | 47,569 | 32,528 | 98,824,531 | 26,908,691 | 172,078,919 | 96,910,936 | 1,845,496 | 10,073 | 217,578,824 | 34,435,659 | 6,798,959 | 49,740,991 | 100,102,387 |
| 1880† | 2,983 | 60,000 | 42,000 | 180,000,000 | 45,959,012 | 187,616,605 | 145,141,798 | 2,471,500 | 12,000 | 237,587,671 | 33,623,887 | 5,056,666 | 129,519,980 | 232,500,000 |

*Of these 1,420 were woolen factories and 2,585 fulling mills for fulling domestic cloths, employing generally only one or two hands.

†The statistics of 1880, so far as the wages, pounds of wool consumed, value of raw material and value of annual product are concerned, are from figures furnished by John L. Hayes, Esq., LL.D., and by Geo. Wm. Bond, Esq., special agent of the Census Bureau in advance of their publication in the Census Bulletins. They are liable to some slight corrections from further information. The importations are from the reports of Commerce and Navigation. The other items are estimates based on reliable data.

‡The wool production is from the census reports.

It appears, then, from the above, that the manufacture of woolens in the United States increased from $20,696,699 in 1840, to $234,587,671 in 1880, according to the national census.

The production of cloths labors under disadvantage from the sharp competition which the English, Belgians, and French have kept up to obtain the American market. Up to 1840, 19–20ths of the cloths and cassimeres imported into the United States were of English manufacture. The importations have been as follows:—

IMPORTS OF CLOTHS AND CASSIMERES INTO THE UNITED STATES.

| | Germany. | Belgium. | France. | England. | Total. |
|---|---|---|---|---|---|
| 1840 | 16.612 | 93.135 | 89,767 | 4,490,830 | $4,690,344 |
| 1851 | 1,411,282 | 478,532 | 1,988,181 | 3,785,070 | 7,463.065 |
| 1857 | 2,574,871 | 909,331 | 1,659,470 | 5,711,933 | 10.855,605 |
| 1868 | .. | .. | .. | .. | 7,139.605 |
| 1870 | 2.930,941 | 165,483 | 273.276 | 4,274,927 | 7,671,013 |
| 1875 | 2.506.628 | 415,347 | 2,868,041 | 7.853.941 | 13,680,288 |
| 1879 | 1,314,109 | 211,710 | 1.458,322 | 3.209,955 | 6,255,195 |
| 1881 | 2,792,374 | 699,858 | 2,639,623 | 5,692,143 | 12,078,733 |

The tariff of 1841 and 1842 approached, by the biennial reductions, the 20 per cent. limit, and on these goods there was not much increase of duties till 1860, when the Morrill tariff went into effect, and which was succeeded, in 1867, by another giving nearly as great protection. Under these successive tariffs, our production of cloths has increased, notwithstanding the sharp competition of foreign manufacturers, who were bound to hold our market, even if they did not make any profit themselves. They had the advantage of cheap labor, and of machinery; and since 1851, at the time of the Crystal Palace exhibition, they have persistently attempted to occupy our markets with their cloths and cassimeres. As the above table shows, the Germans and Belgians, learning what our market demanded at that exhibition, made their goods so much superior to the English in their dyeing and finishing that they gained materially on Great Britain in the amount of their sales, for some years; but by increased exertions and a larger outlay of capital that country measurably recovered its ground. The sharp competition of Germany, Belgium, France, and England has kept down prices for the last thirty years, and our manufacturers have had hard work to hold their own; but the long fight seems to be drawing to a close. Although our population has more than doubled since 1857, we are not importing many more cloths and cassimeres than we did at that time (in 1880 we imported $82,000 less than in 1851); while our own manufacturers are having orders for all the goods they can make, and are now producing four times as many of these goods as they did twenty-five years ago; the foreign goods have not held their own in quality, as the price at which they were exported did not warrant their using the best material; while our manufacturers have been constantly improving the quality of their goods, which are now admitted by good foreign judges to be equal to any manufactured anywhere. Our manufacturers deserve great credit for the courage they have manifested in this long conflict, and their success is due in part to two circumstances: they have used for their warp the best quality of Merino wool, an American product, which, as Dr. George B. Loring well says, "can hold together in the manufactured article more feeble wool than any other similar fiber in the world;" they could thus use cheaper wools for filling, and yet produce first-class goods; they have had the advantage also of American improvements in machinery, and the American machines for the production of cloths and cassimeres are very far in advance of any others in the world. Shawls which so lately as 1872 were imported to the value of $3,424,309 had fallen off in 1881 to $1,079,780; blankets, which in 1872 were imported to the value of $38,785, have ranged in the last three years from $1,675 to $6,062; dress goods in 1872 amounted to $20,439,481, and in 1881, a year of great business prosperity, to only $12,514,-962; the importation of hosiery and knit goods has increased slightly from 1872, when it was $658,193, being in 1880 $611,912, and in 1881, owing to a large demand from immigrants, rising to $1,-000,372; but the home production has increased in a still greater degree; while carpets which 25 years ago were imported to the value of over $20,000,000 fell to $5,-727,183, and in 1881 to $1,064,076—and as the Persian and Smyrna rugs so largely manufactured in England and Scotland are now manufactured in this country of equal excellence and genuineness, and all the other qualities of imported carpets also, there is no good reason why the importation of carpets should not wholly cease. It is worthy of remark also that we are now exporting woolen goods, and that our exports have risen from $124,099 in 1874 to $331,083 in 1881, and that this includes a considerable amount in carpets.

The fact has been developed by the most elaborate scientific researches, that the climate and soil of the United States are better adapted to the growth of fine, long stapled wools, suitable for the cloth manufacturer, than any other *manufacturing* country, and the article produced exceeds the Australian wool. Under the appliances of increased capital, and the stimulus which the competition of England with the continent may impart to the quality of the fabric, the United States will probably assume the superiority; and our manufacturers have not neglected the necessary exertion to procure as fine a finish and as durable a dye for their cloths as those of the continent exhibit. The United States wools are rapidly gaining a character which will bring the foreign manufacturers into such competition for their purchase as will permanently sustain their price.

The supply of wool in the United States has never been equal to the demand.

The wools imported into the United States, are mostly of the coarser descriptions used for carpets, etc., and the average value is about 12 to 21 cts. There are also combing wools of somewhat higher prices, imported from Canada, as we do not yet raise these in sufficient quantity for our growing worsted manufacture. In consequence, Congress, in 1857, made all wools costing less than 20 cents at the place of growth, free of duty. These had paid 30 per cent., ad valorem, previously. This law had not much effect in increasing the supply, for the reason that the supply is everywhere short. There were quantities of South American wool imported of a fine quality, but so filled with the burr peculiar to that country, as to make them nearly useless. Many machines were invented to remove these burrs, but with partial success. One was of the form of a number of circular saws, 8 to 10 inches in diameter, set close together upon a shaft, which revolved with much velocity. The wool was fed to this cylinder, through two rollers. The saw teeth seized the wool, which, passing between the saws, left the burr on the surface, whence it was removed by the motion of the cylinder against a stationary knife placed longitudinally across it. The general impulse given to manufactures at home and abroad, has caused the demand to outrun the supply of wool. This was the more the case that manufactures spread in those countries that formerly were most depended upon for raw wools. The supply of England has been kept up by the extended exports of Australia and the Cape of Good Hope. Hence, the lower duty did not improve the supply in the United States, and the home supply, though at one time diminished has been of late increasing rapidly. At first it seemed that the demand for the flesh of sheep and lambs would diminish the production of wool; but the introduction of the worsted manufacture, by bringing about for combing wools has rendered the production of mutton sheep an advantage. The price of wool, however, rose for a time, and the manufacturers naturally sought to reduce the cost of the raw material by hunting up a substitute. This is usually found in substituting one of these four chief materials of human clothing—cotton, silk, wool, and flax. The one of these that is relatively dearest is mixed with larger proportions of the others. Hence, the value of the whole becomes in some degree equalized.

Out of these circumstances has grown one of the most curious manufactures that have sprung up of late years. This is the shoddy manufacture. It has recently been imported from England; and there are now in New York state six factories—in Watervliet, Newburg, Troy, and Marlborough. These turn out about 100,000 lbs. of shoddy per annum.

Many people, remembering the expression as used to designate anything not considered remarkably fine and good, will ask, "But what is shoddy?"

In the somewhat hilly district of Yorkshire, between Huddersfield and Leeds, stand on two prominences the pretty little towns of Dewsbury and Batley Car. The stranger, on alighting from the railway car, is struck with the unusually large warehouses, built of stone by the railway company. For such small stations, these are mysterious erections. But if he enter the principal warehouse, he will probably find piled up hundreds of bales, containing the cast-off garments of Great Britain and the continent of Europe. Here, in fact, from all parts of the world, are brought the tattered remains of the clothes, some of which have been worn by royalty in the various courts of Europe, as well as by the peers and peasants. The rich broadcloth of the English nobles here commingles with the livery of their servants and the worsted blouses of the French republicans; while American undershirts, pantaloons, and all other worsted or woollen goods, may there be found, all reduced to one common level, and known by one common appellation of "rags."

The walls of the town are placarded with papers announcing public auctions of "Scotch shoddies," "mungoes," "rags," and such like articles of merchandise, and every few days the goods department of the railway is besieged by sturdy-looking Yorkshiremen, who are examining, with great attention, the various bales, some of which are assorted into "whites," "blue stockings," "black stockings," "carpets," "shawls," "stuffs," "shirtings," "linseys," "black cloth," etc. A jovial-looking man, of doubtful temperance principles, at last steps forward and puts the goods up to auction. The prices which these worn-out articles fetch are surprising to the uninitiated. Old stockings will realize from $35 to $50 a ton; while white flannels will sometimes sell for as much as $100 a ton, and even more. The "hards," or black cloth, when clipped free from all seams and threads, are worth from $100 to $150 a ton. There are common mixed sorts of coarse fabric which can be bought as low as from $15 to $25 a ton; while the "rubbish," consisting of seams, linseys, and indescribables, are purchased by the chemists for the manufacture of potash crystals for from $10 to $15 a ton.

It will be seen that *assorting* these old woollens is equally important with the assorting of the different qualities of new wool; and there is the additional consideration of colors to render assorting still more necessary. It is surprising, however, with what rapidity all this is accomplished. There are some houses where old woollen rags are divided into upward of twenty different sorts, ready for the manufacturer. The principal varieties are flannels, of which there are "English whites," "Welsh whites," "Irish whites," and "drabs." Each of these command a different price in the market: the English and Welsh being much whiter than the Irish, and of finer texture, are worth nearly double the price of the Irish. The stockings are the next in value to the flannels, on account of the strength and elasticity of the wool. The peculiar stitch or bend of the worsted in stocking manufacture, and the hot water and washing to which they are submitted during their stocking existence, have the effect of producing a permanent elasticity which no after process destroys, and no new wool can be found to possess. Hence, old stockings are always in great demand, and realize, for good clean colored sorts, as much as $80 a ton in busy seasons. The white worsted stockings are the most valuable of the "softs," and, when supplied in sufficient quantity, will sell for as much as $140 a ton. Carpets, and other colored sorts, are generally, owing to their rapid accumulation, to be had at very low prices.

"Shoddy," so well understood in Yorkshire, is the general term for the wool produced by the grinding, or, more technically, the "pulling" up of all the soft woollens; and all woollens are soft, except the superfine cloths. The usual method of converting woollens into shoddy, is to first carefully assort them, so as to see that not a particle of cotton remains on them, and then to pass them through a rag machine. This has a cylinder 3 ft in diameter and 20 inches long, with steel teeth half an inch apart from each other, and standing out from the cylinder, when new, one inch. This cylinder revolves five hundred times in a minute, and the rags are drawn gradually close to its surface by two fluted iron rollers, the upper one of which is packed with thin stuff or skirting, so as to press the rags the closer to the action of the teeth. The cylinder runs upward past these rollers, and any pieces of rag which are not completely torn into wool, are, by their natural gravity, thrown back upon the rags which are slowly creeping into the machine. The rollers are fed by means of a creeper, or slowly moving, endless cloth, on which a man, and in some instances a woman, lays the rags in proper quantities. One of these machines is commonly driven by a seven-inch band, and requires at least five horse power. Half a ton of rags can be pulled in ten hours by one of these machines. The dust produced subjects the workpeople on first commencing the occupation, to what is there called the "rag fever." But after a time the immediate effects are warded off, and although it no doubt shortens life, the remuneration being considerable—in England, 2s. for every 240 lbs. of rags pulled—there is never any difficulty in obtaining workpeople.

The "mungo" is the wool produced by subjecting the hards, or superfine cloths, to a similar operation as that above described. The machine, however, for the mungo trade, is made with a greater number of teeth, several thousand more in the same sized cylinder, and the cylinder runs about 700 revolutions in a minute. The rags, previous to being pulled in this machine, are passed through a machine called a "shaker." This is made of a coarsely-toothed cylinder, about $2\frac{1}{2}$ ft. in diameter, which revolves about 300 times in a minute, in a coarse wire cylinder. This takes away a large portion of the dust, which is driven out at a large chimney by means of a fan. The mungo pulling is, therefore, a cleaner business than the shoddy making, and, as a general rule, is more profitable. The power required for a mungo machine is that of about seven horses.

Both the better kinds of shoddy and the mungo have for some years been saturated with oil; but recently, milk has been applied to this purpose, and found to answer exceedingly well. The consequence is that milk in that locality, in England, has risen 100 per cent. in price; and even in that district, where cows are kept in large numbers, it was feared there would be a great scarcity of milk for the supply of the towns.

When well saturated with oil or milk, the shoddy or the mungo is sold to the woollen manufacturer. There are scores of men who attend the Huddersfield market every Tuesday to dispose of their mungo. It is as much an article of marketable value there, as cloth is here. It is not unusual for good mungo to realize as much as eight Englsh pence per pound, while the shoddy varies in price from one penny to sixpence per pound, according to quality.

The common kinds of shoddy require, of course, to be subjected to the scouring process, for which large wooden heaters, or "stocks," are employed. The dung of hogs is largely employed in this purifying process, as well as human urine, which is extensively used in the blanket manufacture of Yorkshire.

The white shoddy is capable of being used either for light-colored goods or for the common kinds of blankets, while the dark-colored shoddy is worked into all kinds of coarse cloths, carpets, etc., which are dyed any dark color, so as to hide the various colors of the old fabrics. It is mixed in with new wool in such proportion as its quality will permit, without deteriorating the sale of the material.

The mungo is used in nearly all the Yorkshire superfine cloths, and in some very extensively. It produces a cloth somewhat inferior, of course, to the West of England goods in durability, but, for finish and appearance, when first made up, the inferiority would only be perceived by a good judge of cloth. This substance is largely introduced into all felted fabrics. Blankets, carpets, druggets, table-covers, and Petersham coats, are sometimes entirely made from it, and the trade is rapidly extending.

The effect of shoddy in the cloth of an overcoat, in the wear, is to rub out of the cloth and accumulate between it and the lining. We have seen a gentleman take a handful of this short wool from the corners of his coat.

The grounds on which this shoddy and mungo business can be justified are the cheapening of cloth, and the turning to a useful purpose what would be otherwise almost useless.

The business in Yorkshire is dignified by the title of the "Dewsbury trade;" and to it Dewsbury certainly owes its wealth, and we might almost say its existence. In twenty years it has grown from a village to a town of some 30,000 inhabitants, and some immense fortunes have been made by this extraordinary transformation of old garments into new.

Considerable quantities of white shoddy were sent from England and Scotland to this country, and finally a machinist sent several of his rag machines, and several factories were successively started. The sale of the product is now largely conducted in Cedar street, New York.

The shoddy trade is somewhat fluctuating, being affected very much by the state of the wool market. So great is the competition in the markets, that as soon as a rise takes place in the price of new wool, the small manufacturers, instead of raising their prices, commonly regulate their expenditure by using a larger proportion of the old material, and they are thus enabled to compete, in prices at least, with the larger manufacturers, who can lay in a large stock of new wool when the prices are low.

# LEATHER.

## CHAPTER I.

### TANNING—BOOTS AND SHOES.

On the formation of the federal government, much solicitude was apparent in relation to the growth of the more important branches of manufactures. That the imperial government had so persistently prevented the establishment of any considerable branches, was a great drawback, because it had prevented the development of the necessary experience and skill in manufacture required for large operations. The removal of those prohibitions by the act of independence, attracted attention to the forbidden industries, and they began to flourish. The tanning and manufacture of leather, in all its branches, was one of the first that began to thrive, and naturally, because the slaughter of animals for food furnished a greater or less supply of skins, that required to be wrought up into boots, shoes, harness, etc. Parliamentary committees, early in the eighteenth century, mentioned tanning in the colonies as a branch of individual industry, which supplied most of the local demands for leather and shoe-making, as one of the leading handicrafts.

In 1791, the Secretary of the Treasury, Mr. Hamilton, in his report on manufactures, mentions: "Tanneries are not only carried on as a regular business in numerous parts of the country, but they constitute, in some places, a valuable item of incidental family manufacture." He went on to mention, that encouragement had been asked of the government in two ways, viz.: by prohibiting both the import of the leather and the export of the bark. It was alleged that the leather trade had raised the price of bark from $3 to $4½ per cord. He ascribed the rise, however, rather to the increase of tanneries than to the export, of which, he said, there was no evidence. Glue was then a large item with the tanners, who used up the refuse portions of the skins in that way. From that time to the present, tanners have increased in all the states, in the proportion nearly of the growth of the population. The importation of boots and shoes was always insignificant, comprising high-priced articles from Paris mostly. Thus, the year 1822 was one of the largest import: there were then 14,979 pairs of shoes, mostly kid and morocco, imported, for $9,192; and 207 pairs of boots, for $792, or nearly $4 per pair. In 1858 the importation was only 39,826 pairs of leather boots and shoes, at a value of $87,101; and the export of domestic boots and shoes in this year was 609,988 pairs, or a value of $663,905: showing a large excess of exports over imports.

The manufacture of boots and shoes has, therefore, been in the double ratio of the number of people, and their ability to buy, in proportions as follows:—

LEATHER MANUFACTURE OF THE UNITED STATES IN 1870.

| | Establishments. | Capital. | Raw Material. | Male. | Female. | Labor. | Product. |
|---|---|---|---|---|---|---|---|
| Boots and Shoes..... | 23,699 | $49,852,926 | $95,399,556 | 116,385 | 22,378 | $52,765,669 | $185 033,181 |
| Gloves.............. | 221 | 2,340,550 | 1,884,146 | 1,146 | 2,912 | 980,549 | 3,998,521 |
| Leather Belting...... | 91 | 2,118,577 | 3,231,204 | 792 | 16 | 454,187 | 4,558,043 |
| Morocco Dressers.... | 113 | 3,854,072 | 6,623,066 | 2,782 | 224 | 1,678,226 | 9,997,460 |
| Patent Leather....... | 26 | 906,000 | 3,211,749 | 518 | 10 | 341,445 | 4,018,115 |
| Saddles and Harness. | 7,607 | 13,935,961 | 16,068,310 | 22,949 | 608 | 7,046,207 | 32,709,981 |
| Tanners and Curriers. | 7,438 | 56,632,740 | 108,870,494 | 31,544 | 359 | 12,524,464 | 143,464,522 |
| Total............. | 39,195 | $129,640,826 | $235,288,525 | 176,114 | 26,507 | $75,790,747 | $383,779,823 |

The total value was thus raised to $383,779,823. The value produced by the tanners and curriers was $143,464,522. Of this leather so produced, the harness-makers and shoemakers used $111,467,866. The tanneries lie at the foundation of the whole. They use the skins and hides of animals slaughtered in the whole country, and require, in addition, an average of some $14,-400,000 worth of foreign hides, imported mostly from Central and South America, and the British East Indies, to make good the demand. The census of 1870 gave the sides of sole leather tanned at 17,577,404, and of upper leather, 9,133,330.

The supply of hides in the country originally was derived mostly, if not altogether, from the slaughter of animals for food. Tanneries were started where bark, mostly hemlock, was most easily accessible, and the tannery became the market for hides and skins for many miles around, as well for the farmers as butchers. In the neighborhood of the large cities, foreign hides became the main resource. Thus, in 1880, the value imported was $30,002,254, as follows: Boston and Salem, $7,391,416; New York, $20,430,171; Philadelphia, $182,182; Texas ports, 876,016; San Francisco, $235,140; Baltimore, $149,736. The importers of hides sell to the tanners for cash or short time, and then tanning takes place in localities best suited to the combination of the materials. The greater part of the bark now used in the New York tanneries is obtained from the central counties of Pennsylvania; but with the destruction of the forests there has come a great change in the methods and materials of tanning. The process is much shortened, and extracts of bark, catechu, sumac, wattle, mezquite, hardhack, and other trees, shrubs, and gums, containing a large amount of tannin, are used in place of the bark itself. Sumac is becoming one of the most important materials for tanning, and is largely imported from Sicily, Italy, and France, though some of our native species, if properly prepared, are fully equal to the foreign. The ailantus, which belongs to the same family, might also be used.

The census has not furnished in any definite manner the number of hides that are produced each year in the country, although it is a very important item. That of 1840 gave the number of sides tanned in 1839 at 3,463,611, which would account for 1,731,805 hides. The number of neat cattle in the country was then 14,971,586, and of horses and mules 4,335,669. The deaths among them would give about 400,-000 hides, and the neat cattle would give 3,000,000 hides. The number of horses, cattle, and other domestic animals in the United States, in 1870, according to the census of 1870, was:—

| | |
|---|---|
| Horses and Mules, | 8,815,634 |
| Cattle, | 28.074,582 |
| Sheep, | 28.477,951 |
| Swine, | 25,134,569 |

According to the census, the number of cattle slaughtered in a given year is about 25 per cent. of the whole number. This would make the slaughtered cattle of 1869, according to the estimate, 7,018,645, and the horse hides (10 per cent.) would be 881,563. The number of skins dressed of native animals, which includes sheep and goat-skins, calf-skins, kid, horse, hog-skins, and also a very considerable number of deer, buffalo, and alligator skins, was 13,-879,115. The sheep-skins dressed in 1850 alone numbered 6,000,000. The numbers of live stock in the autumn of 1880, according to the report of the Agricultural Department, were as follows:—

| | |
|---|---|
| Horses and Mules, | 13,825,800 |
| Cattle, | 33,945,700 |
| Sheep and Goats, | 50,863,700 |
| Swine, | 34,967,400 |

Our importation of hides and skins, mostly from Central and South America, in 1868, was valued at $9,961,999, and in 1880 amounted to 30,002,254. As these hides and skins had to undergo the processes of tanning and dressing after their arrival here, they probably represented in 1880 a value of at least $65,000,000. The price of leather has nearly doubled since 1860, and while the importation is increasing in amount, the home product does not decline in price. The statistics of the tanneries in 1840, 1850, 1860, and 1870 are as follows:—

| | No. | Capital. | Sides tanned. | Skins. | Value of production. |
|---|---|---|---|---|---|
| 1840, | 8.229 | 15,650,929 | 3.643,611 | 3.781,868 | $20.919,910 |
| 1850, | 6,263 | 18,900,557 | 12,257,940 | 8,653,865 | 32,861,796 |
| 1860, | 5,040 | 35,655,370 | Cost of raw material. | $44,720,737 | 67,306,452 |
| 1870, | 7,438 | 56,632,740 | 26,710,734 | 73,879,115 | 143,464,523 |

The skins of domestic animals, or "green hides," are rated of higher value than the foreign or salted hides; yet these latter will give a greater weight of leather, because of the water in the green hides, which, on the other hand, are more easily handled. The largest oxen make the best sole leather. The skins of the bull are thickest about the neck and parts of the belly; but the back is thinner, and are inferior in fineness of grain to oxen or cows. The best are made into the heavy leather, used for the best trunks, shoe-soles, machine-belts, harness, etc. The lighter qualities serve for uppers of common boots and shoes. Kips, or skins of young cattle, make the uppers of fine boots and shoes. Those hides of the best quality only are split or shaved for the thin enamelled leather used for dress shoes, and are made into "lace leather," or thongs for belts. In preparing the hides for tanning, the heavy ones are soaked for months in lime-water. The hair, at last, can be removed, with the epidermis, by the two-handed scraping-knife, rubbed over it as the hide is laid flat down on the bench prepared for this purpose. The fleshy substance on the other side is then scraped off, and, like the head, cheeks, and other waste, used for making glue. In large establishments, machines are used for this scraping. The lime that remains in the pores of the hide must be removed by soaking in some solution, like chlorine, that will form a soluble compound with the lime. Sometimes hides are laid in piles, and allowed to begin to putrefy, great care being taken to stop it as soon as the hair starts. By the United States plan, the object is more effectively obtained, with less labor, and no injury to the leather. The hides are suspended in a cool vault, protected, like an ice-house, against the entrance of warm air, and furnished with a covered channel-way, that answers as a drain and as a conduit for cool damp air. Cool spring water is then conducted into the vault, to fall round its sides like spray. The hides are thus kept in a mist, at a temperature of 44 to 46 deg., and, in six to twelve days, are found freed from all superfluous matter. The cold vapor has been absorbed, and its action by melting has distended and removed the epidermis with the roots of the hair. As soon as this is effected, the hides are ready for tanning. This American plan, it will be observed, is far in advance of that of the old systems, still practised in Europe.

Of the hides brought into New York in a year, the disposition was as follows:—

| | | |
|---|---|---|
| Domestic hides, slaughtered | 250,000 | |
| Imported | 1,902,000 | |
| Stock, Jan. 1 | 375,000 | |
| Supply | 2,527,000 | |
| Taken for sole leather | 1,877,000 | |
| " upper " | 250,000 | |
| " patent " | 100,000 | |
| " by western tanners | 100,000 | |
| " neighboring cities | 150,000 | 2,477,000 |
| Stock, Dec. 31 | | 50,000 |

These figures show the relative disposition of the hides sold in New York.

Leather, tanned, is generally divided into three kinds, namely: hides, kips, and skins. The stoutest leather employed for trunks and soles of boots and shoes, is made from butts or backs. Buff leather was formerly made for defensive armor from the hide of the buffalo, but it is now furnished by the cow-hide, and is used chiefly for soldiers' belts. Bull-hide is thicker than cow-hide, while kip-skin, from young cattle, is lighter than the latter. The name kip is also given to Calcutta, Brazil, and African hides. Calf-skin supplies the great demand for the upper part of boots and shoes; sheep-skins form a thin, cheap leather; lamb-skins are used for gloves; goat and kid-skins form a light leather of fine quality; deer or antelope are usually bi-dressed in oil; horse-hide is prepared for harness work, etc., and this, with seal-skin, is used for making enamelled leather; dog-skin makes a thin, tough leather, but most of the gloves sold as dog-skin are made of lamb-skin. Hog-skin makes a thin, porous leather, and is used for covering the seats of saddles; ass and mule-skins are for shagreen leather, used mostly for scabbards. There is a large import trade in skins. The great demand for leather for the best gloves is supplied by lamb-skins from Italy, Spain, the south of France, and other parts, where, in consequence of the lamb being killed quite young, the skin is small, fine, and thin, and is used instead of kid; but it is neither so strong nor so glossy. The skins of lambs that die soon after their birth, are sometimes dressed with the wool, and are used for lining gloves and shoes. The best kid-skins are from the south of France; they are also imported from Germany, Switzerland, Italy, and Ireland. It is said that as soon as the kid begins to feed on herbage, the skin suffers in fineness and delicacy, and is no longer suitable for the best gloves. The best morocco leather is made from Swiss goat-skins; another kind is from Mogador and East Indian goat-skins, which are often made into black morocco, known as "black Spanish leather," from the circumstance of the first supplies having been obtained from Spain. The leather from the Cape sheep-skin is nearly equal to morocco. Hippopotamus hides are exported from South Africa, and when tanned with oak bark they make an extremely thick and compact leather. In Canada, in 1860, leather was made from the white whale which visits the St. Lawrence. An excellent quality of goat and kid leather is made from the skins of the Angora goat and kid, which are now largely reared at the Cape of Good Hope, and in some of our western states.

The vegetable substances used in tanning have of late years become very numerous. The active vegetable principle, tannin, varies according to the source from which it is derived; it is always marked by an astringent taste, a bluish-black or dark green precipitate in aqueous solution by admixture with a solution of one of the salts of iron; while, with a solution of gelatine, it gives a dirty white or brown precipitate. During a long period the principal tanning material was oak bark and hemlock bark. That which was stripped in the spring was the most esteemed, for it then contained a larger quantity of tannin than that stripped in autumn, and this more than the bark stripped in winter. The best bark was obtained in a warm spring, from coppice trees about twelve years of age. Oak bark contains from 4 to 22 per cent. of tannin, which is contained in the inner white layers next the alburnum, as in the case of other astringent barks. The tannin of bark is not identical with that of galls, not yielding pyrogallic acid when subjected to destructive distillation; from four to six pounds of oak bark were required for every pound of leather. After the stripping, the bark was stacked to dry; should the season be rainy, a portion of the tannin was washed out, and the bark thus deteriorated. When the tanned leather is taken in hand by the currier, it is softened by being soaked in water. It is next beaten by a mallet upon a hurdle, and then placed over a plank called a beam, which projects slantingly from the floor. The workman leans over this and against the leather, so as to keep it in its place, and with a broad knife shaves off all the irregularities from the flesh side. The knife is held firmly in both hands, and the operator continually examines the skin, and moves it to bring all parts under the knife. After it is shaved, it is thrown into cold water, the flesh side laid next to a stone slab, and the other well rubbed with a tool called a stretching iron. This process forces out a whitish matter (bloom) gathered in the tan pit, and reduces inequalities. Many tools are employed, having the same object. The skin then undergoes "dubbing;" an ointment of cod oil boiled with the skins of sheep, is well rubbed in on both sides, and the leather hung up to dry. It is afterward rubbed with the graining board—an instrument shaped somewhat like a brush, but grooved, and made of hard wood. The leather is then ready for sale; or, after shaving the flesh side with a very sharp knife, it is waxed. A color, composed of oil and lamp-black, is well rubbed in on the flesh side, with a hard brush, until the surface is thoroughly black; upon this is applied a size and tallow with a stiff brush, and when dry, it is rubbed with a broad, smooth lump of glass; this is repeated. This leather is called "waxed," or "black on the flesh," and is used for the uppers of men's boots and shoes. If curried on the other side it is called black on the grain, and is used for ladies' uppers. In preparing such leather, the waxing is performed as follows: a solution of sulphate of iron, called copperas water or iron liquor, is applied to the grain side of the wet skin, when the salt, uniting with the gallic acid of the tan, produces an ink dye; stale urine is then applied to the skin, and when dry, the stuffing is applied. The grain is raised, and when dry, the skin is whitened, bruised, and again grained; after which, a mixture of oil and tallow is applied to the grain side, and it undergoes carefully the treatment with the pommel or graining-board again, and several other processes of rubbing, polishing, and dubbing, or oiling. These duly performed, with due regard to time and circumstances, complete the process.

For many years it was found difficult to cause a bright varnish to adhere to leather without cracking, an effect which is now produced by means of boiled linseed oil mixed with vegetable black and Prussian blue. This composition, of the consistence of a thick paste, is rubbed upon the surface of the leather, and then dried at a temperature of from 150° to 170° Fahr. The process is repeated from three to seven times, and when quite dry, the varnish adheres very firmly, and will bear considerable flexure and tension without cracking. By mixing colored pigments with the varnish, enamelled leather of various colors may be produced.

The process of tanning differs considerably in the mode of treatment with the kind of skin and the result desired. A large number of thin leathers which are intended to be dyed, are tanned in various ways. White leathers are not tanned, but tawed, or treated with alum, salt, and some other matters. Wash leather is dressed with oil, or shamoyed; but whatever may be the subsequent treatment, the preparatory steps somewhat resemble each other—whereby hair, wool, grease, and other matters, are removed, and the skin is reduced to the state of a gelatinous membrane called pelt; the hair is removed from kid and goat-skin, by means of cream of lime; the wool is generally removed by the feltmongers before the skin is passed to the tawers.

Foreign lamb-skins, which are received with the wool on, are washed, scraped on the flesh side, and sweated in a close room, until, in consequence of the putrefactive fermentation, the wool can be easily removed. After this, fatty matters are got rid of by subjecting the skins to hydrostatic pressure; they are next worked at the beam and pared into shape, treated with lime, and next with dogs' or pigeons' dung, if the skins are to be tanned, and with bran and water if they are to be tawed, the object being, in either case, to get rid of the lime. During these operations, the skins are worked a few times at the beam, and are finished by washing in clean water. Morocco leather is prepared by tanning goat-skins with sumac, and dyeing on the grain side. Inferior moroccos are prepared from sheep-skins similarly treated, for which purpose each skin of pelt is sewed up into a bag, the grain side outermost, distended with air, and placed in a mordant of tin or alum. They are next placed in a warm cochineal bath for red, indigo for blue, orchil for purple, and are worked by hand until the dye has properly struck. For certain colors the tanning precedes the dyeing. The tanning or sumacing is carried on in a large tub, containing a weak solution of sumac in warm water; another and stronger solution is contained in an adjoining vessel, a portion of which, together with some sumac leaves, is poured into the bag; some of the weak solution is then added, the bag is distended with air, and the skin thrown into the vat. In this way about 50 skins are treated, and are kept in motion a few hours in the sumac tub, by means of paddles worked by hand, or by machinery. The skins are then taken out and heaped upon a shelf at the side of the tub, the pressure thus produced causing the liquor to escape slowly through the pores of the skin, the bags being shifted about from time to time. The bags are next passed into a second vat, containing a stronger solution, where they remain for nine hours. The bags are now opened and washed; fine red skins being finished in a bath of saffron. All the skins are next struck on a sloping board until they are smooth and flat, and in order to improve their appearance in the currying, a little linseed oil may be rubbed on the grain side; they are then hung up in a loft to dry, when they become horny and are in the crust, as it is called; they next pass through much laborious friction with the pommel, and with a glass ball; while the peculiar ribbed appearance of morocco is given by means of a ball of box-wood, on which is a number of narrow ridges. Sheep-skin morocco is prepared from split skins; the skin-splitting machine resembles in principle that hereafter described, only as the membrane is thinner, certain variations are required. Instead of stretching the skin on a drum, it is passed between two rollers, the lower one of gun-metal, and solid, and the upper made of gum rings; while between the two rollers, and nearly in contact, is the edge of the sharp knife, which is moved by a crank, as hereafter mentioned. When a skin is introduced between the two rollers, it is dragged through against the knife edge and divided, the solid lower roller supporting the membrane, while the upper one, being capable of moving through a small space by means of its rings, adjusts itself to inequalities in the membrane; where this is thin the rings become depressed, and when it is thick they rise up, so that no part escapes the action of the knife. The divided skins are not sewed up into bags, as, from their thinness, they can be sumached quickly.

In preparing white leather by "tawing," the pelt is made as pure as possible; the best kind of leather being prepared from kid-skins, while sheep or lamb-skins make the inferior kinds. They are first fed with alum or salt in a drum or tumbler made like a huge churn; about three pounds of alum and four pounds of salt being used to 120 skins of average size. The alumina of the alum forms some definite compound with the gelatine of the skins, while the salt serves to whiten them. When taken out, the skins are washed in water, then allowed to ferment in bran and water to remove the surplus alum and salt, and to reduce the thickness. They are next dried in a loft, and become tough and brittle, but they are made soft and glossy by means of a dressing of twenty pounds of wheat flour and the yolks of eight dozen eggs. By rotating the skins in drums for some time the dressing is absorbed, and scarcely any thing but water remains. This dressing is usually repeated, and the skins hung up to dry. The beautiful softness and elasticity of leather is now given by manipulation. The skins are first dipped in clean water, worked upon a board, and staked upon a stretcher or softening iron, consisting of a rounded iron plate fixed to the top of an upright beam, by which the skins are extended and smoothed; they are then finished by being passed over a hot iron.

The tanning of leather, more than almost any other manufacture, is a chemical process, the success of which depends almost wholly upon the skill and judgment with which its complicated manipulations are conducted. To attain the requisite skill in the laboratory of the chemist is evidently impossible; it can only be acquired in the tanning itself, by long and careful attention and observation; and perhaps there is no description of manufacture where so much depends upon practical knowledge, and so little upon mere theory, as in the tanning of leather. The tanning of leather consists in effecting a combination between the gelatine, which is the main constituent of raw hides, and tannin, a peculiar substance, found in the bark of several species of trees—the oak and hemlock chiefly. The processes employed are so various, and the modifications occasioned by temperature, strength of the liquor, and quality and condition of the hides, are so numerous and so different, that hardly any branch of business requires for its successful conduct a greater degree of judgment and experience, and in few arts have there been effected greater improvements. Within twenty years the gain of weight in converting hides into leather has increased nearly fifty per cent.; that is, from a quarter to a third more leather can now be obtained from a given quantity of hides than in the old-fashioned way.

The great improvement in weight seems to have been gained by the judicious use of strong liquors, or "ooze," obtained from finely-ground bark, and by skilful tanning. In order to produce heavy weights, the hides should not be reduced too low in the beam-house, and should be tanned quickly with good strong liquors, particularly in the latter stage of the operation. To green hides, particularly, nothing can be more injurious than to suffer them to remain too long in weak "ooze." They become too much reduced, grow soft, flat, and flabby, lose a portion of their gelatine, and refuse to "plump up." On the other hand, however, the effects of an early application of "ooze," that is too strong and too warm, to green hides, is very injurious. It contracts the surface fibres of the skin, tanning at once the external layers, so "dead," as it is termed, as to shut up the pores, and prevent the tanning from penetrating the interior. This renders the leather harsh and brittle.

In softening hides, and preparing them for the process of tanning, a great deal also depends upon the judgment of the person superintending the operation, inasmuch as the diversities in the qualities and characteristics of hides render it impossible to subject them to any thing more than a general mode of treatment. In "sweating," the character of the hides and the temperature are essential, but ever-varying considerations. As a general rule, however, the milder the process of preparing the hides for the bark, the better. Unnecessarily severe or prolonged treatment is inevitably attended with a loss of gelatine, and a consequent loss of weight and strength in the leather. Too high a temperature is particularly to be avoided.

In almost every lot of hides, particularly the Orinocos, however, there are generally some that prove very intractable, resisting all the ordinary modes of softening. For such, a solution of ashes, potash, or even common salt, will be found to be beneficial.

As we have said, no precise rule can be given as to the length of time required for the preliminary process of soaking and "sweating"—so much depending upon the qualities of the hides, and the temperature at which these operations are conducted.

The following table, however, may be found useful in conveying an approximation to a definite idea of the practice in a large tannery:—

| Temperatures. | Soaking. 40° Days. | Soaking. 50° Days. | Soaking. 60° Days. | Soaking. 70° Days. | Sweating. 40° Days. | Sweating. 50° Days. | Sweating. 60° Days. | Sweating. 70° Days. |
|---|---|---|---|---|---|---|---|---|
| Buenos Ayres hides........ | 10 to 12 | 8 to 12 | 6 to 8 | 3 to 6 | 15 to 20 | 12 to 16 | 8 to 12 | 2 to 3 |
| Carthagena and Laguayra... | 8 12 | 7 9 | 5 7 | 2 5 | 15 20 | 10 15 | 6 8 | 2 3 |

Salted hides do not require more than about two-thirds the time to soak, but about the same time to sweat. In sweating, the temperature rises as the hides sweat, so that the operation is seldom performed under 50°. It is particularly recommended that, for the tougher hides, the heat should never be greater than 60° or 65°.

After the hides are prepared for tanning, the next process is what is commonly called "handling," which should be performed two or three times a day in a weak ooze, until the grain is colored, new liquor being preferable to old. They are then, after a fortnight, laid away in bark, and changed once in two to four weeks until tanned. Much care and judgment is requisite in proportioning the continually increasing strength of the liquors to the requirements of the leather in the different stages of this process. The liquors should also be kept as cool as possible, within certain limits; but ought never to exceed a temperature of eighty degrees. In fact, a much lower temperature is the maximum point, if the liquor is very strong —too high a heat, with the liquor too strongly charged with the tanning principle, being invariably injurious to the life and color of the leather. From this, it would seem that time is an essential element in the process of tanning, and that we cannot make up for the want of it by increasing the strength of the liquor, or raising the temperature at which the process is conducted, any more than we can fatten an ox or a horse by giving him more than he can eat. It may be questioned whether any patented schemes for the more rapid conversion of hides into leather, will be found, on the whole, to have any practical utility.

We have mentioned the injurious effects resulting from too strong a solution of the active principle of the bark; on the other hand, the use of too weak solutions is to be avoided. Hides that are treated with liquor below the proper strength, become much relaxed in their texture, and lose a portion of their gelatine. The leather necessarily loses in weight and compactness, and is much more porous and pervious to water. The warmer these weak solutions are applied, the greater is this loss of gelatine. To ascertain whether a portion of weak liquor contains any gelatine in solution, it is only necessary to strain a little of it into a glass, and then add a small quantity of a stronger liquor. The excess of tannin in the strong solution, seizing upon the dissolved gelatine in the weak liquor, will combine with it, and be precipitated in flakes of a dark, curdled appearance, to the bottom. In the best tanneries, the greatest strength of liquor used for handling, as indicated by Pike's barometer, is 16°. Of that employed in laying away, the greatest strength varies from 30° to 45°.

After the leather has been thoroughly tanned and rinsed, it will tend very much to improve its color and pliability to stack it up in piles, and allow it to sweat until it becomes a little slippery from a kind of mucus that collects upon the surface. A little oil added at this stage of the process, or just before rolling, is found to be very useful.

Great caution is necessary in the admission of air in drying, when first hung up to dry. No more air than is sufficient to keep the sides from moulding should be allowed. Too much air, or, in other words, if dried too rapidly in a current of air, will injure the color, giving a darker hue, and rendering the leather harsh and brittle. To insure that the thick parts, or butts, shall roll smooth and even with the rest of the piece, it is necessary that the leather should be partially dried before wetting down for rolling, and that, when wet down, it should lie long enough for every side to become equally damp throughout.

In the tanning records of 200,000 sides, an average of the whole time was five months and twenty-seven days. The average weight of the leather was seventeen pounds per side. This, according to the best authorities we have at hand, is considerably below the time employed in England. There, it is no uncommon thing for from 8 to 15 months to be employed in tanning a stock of leather.

Several new processes of tanning intended to shorten the time and diminish the cost, have been introduced since 1850; one of them whose excellences consist in perfect gradation of the tanning liquors, and a greater facility of permeation and handling, is as follows:

Sole leather hides for *sweat stock* are prepared for the tan liquors in the usual manner. Limed stock for upper and sole leather, for either hemlock or oak tanning, is limed and washed, and bated by the paddle-wheel handlers; after being properly prepared for the tan liquors, it is then handled in a section of vats, in which the liquors communicate as in the press-leaches, except that the order of running the liquors is from near the top of one vat to the bottom of the next, through the whole section, thus "pressing" the weak liquor forward upon the greener stock, giving a *perfect* gradation of strength of liquor on each pack, stronger according to the length of time it has been in; each vat is fitted with a patent paddle-wheel handler, which is used for stirring the stock in the liquors, dispensing with the necessity of handling by hand entirely; in this section stock should be kept two weeks, then taken out and hung over sticks with head and butt down in patented layaways, and not again moved till well tanned; the layaways are all in one section with the communicating trunks, in the same manner as the handlers; when a pack is taken out *tanned*, a pack from the *handlers* is put into its place, and the weakest liquor in the section is allowed to fill the vat; here every part of every side is in contact with the liquor at all times, and the liquors on *every pack* are becoming stronger every day till tanned; the liquors are kept in motion by small paddle-wheels, which operate on the surface of the liquor over the suspended sides, causing the liquors to pass with a gentle current among the sides, bearing them up, so that they do not rest heavily on the sticks.

Two men's labor is sufficient for all the *yard work* for a tannery working *in* and *out* 150 sides per day, including washing the tanned stock and taking it to the loft.

The results of tanning 144,000 hides were as follows:

| | | Weight. lbs. | Average. lbs. | Value. |
|---|---|---|---|---|
| Hides,............. | 144,000 | 3,229.155 | 22.22 | $421,810 |
| Leather, sides,... | 287,275 | 5,316,789 | 18.51 | 704,044 |

This gives a considerable increase in the weight of the hides, and the increase in the value of the article is much greater. That covers, of course, commission, labor, interest, profits, etc. The great development given to general business in the last twenty years has caused an almost continuous rise in the value of leather and hides. The latter, on being purchased and put in the vats, would thus acquire value from the general rise in the market, in addition to the regular value added by the art of the tanners. There was gradually felt a growing scarcity of hides, and the quantities imported by no means kept pace with the rising value. The quantities and values of hides imported for the few last years was as follows:

| No. | 1850. | 1858. | 1869. | 1875. | 1880. |
|---|---|---|---|---|---|
| Hides, | 2,572,884 | 2,493,656 | 3,318,729 | 2,108,861 | 3,636,637 |
| Value, | $5,964,838 | 8,048,825 | 14,204,767 | 18,536,902 | 30,002,254 |

This shows that for 1,063,753 more hides there were paid in 1880 $24,037,416 more than in 1850, in advance of about 500 per ct. in the value of hides, while the labor and tanning material have advanced still more. Such a fact indicates the growing cost of the raw material for boots and shoes, and also indicates the growing value of the hides of animals throughout the country.

Leather being so costly a substance, great efforts are made to introduce economies in its manufacture and use in every direction. One plan for getting the most possible surface out of a given weight, is to split the thick hides into two thinner sheets. This process, formerly difficult, has of late undergone many improvements. When the hide is sufficiently tanned, it is split sometimes into five thicknesses, from a single one. This is done by various machines, in one of which the knife is 72 inches long, or as long as a hide is wide. A late improvement in Boston makes the knife 80 inches long, and economises 25 per cent. in the stock that before was shaved away. The flesh side of the sheet, with the shanks, are used by the trunk-makers to cover wooden trunks, and blackened on the trunks. Other sheets are subjected to a process called "buffing," which consists in shaving off about half the grain, in order to obtain a softer surface to receive an artificial grain. They are then returned to the tan-yard, and, after being scoured, are retanned in warm liquors. They are then sent to the currier to be prepared for japanning. A new patent has been issued for splitting leather with a circular knife, which is of thin metal, made like a disc, convex side up. This revolves horizontally, with its sharp edge just above a table, over which the leather is stretched, and held down firmly to it by springs. Under the table is a roller, which, by revolving, draws the leather forward against the edge of the revolving knife. The upper side of the leather splits off in curls above the knife, which may be nicely adjusted to make the leather of any thickness.

Another invention of considerable importance in cheapening the production without impairing the quality of the articles made from leather, is that known as *leather board*. This is a compound of jute, manilla rope, tarred rope, and scraps of leather reduced to a pulp, and then reduced to the desired form by very heavy pressure. The linings and inner soles of many descriptions of shoes, as well as some other portions of the shoe, and leather toys and fancy leather goods are made of this material, which is stamped by dies into the requisite forms, and is said to resist heat or moisture better than leather itself. About $2,000,000 worth of it was sold in 1880.

The general manufacture of boots and shoes had undergone few changes other than those produced by changing fashions and the regular improvements of business, until the introduction of sewing and pegging machines, which gave a great impulse to the production by affecting prices and disturbing localities. The Massachusetts shoe-makers, by their industry, early obtained an ascendancy in the manufacture, and it is one that is easily adopted in an industrious community. The towns in the neighborhood of Boston, and especially Lynn, attracted masons, carpenters, and other workmen, in the winter season, when their own professions were dull, to pursue shoe-making.

The business thus almost accidentally commenced in Lynn, became in time the principal business of the place, having in 1878, 201 out of its 324 manufacturing establishments engaged either in the manufacture of boots and shoes, or in some branch of trade directly connected therewith. More than 12,000,000 pairs of boots and shoes, mostly for women and children, are made here annually; about 14,000 of its 38,000 inhabitants are employed in the business, and the annual product exceeds $15,000,000. Haverhill, another city of the same county, somewhat smaller, is also very largely engaged in the same business, having 184 establishments for the manufacture of shoes. Marblehead, Worcester, Braintree, and Danvers are also among the principal seats of this manufacture in Massachusetts. The state of Massachusetts had, in January, 1878, 1,461 shoe factories or shops, in which 2,389 persons were partners or stockholders; 48,090 were employed directly in the manufacture, and more than 220,000 were dependent upon it. The capital invested was $18,692,864 and has been largely increased since; the value of the stock or raw material used was $54,976,504; the amount of wages paid $21,883,354, and the value of the goods produced, $89,375,792, being by about twelve millions the largest product of any single industry of that great manufacturing state. Boston is the seat of the principal wholesale boot and shoe trade, shipping over 60,000,000 pairs of shoes annually (worth nearly $70,000,000) to other parts of the United States, and a moderate quantity abroad. New York is the largest exporting port, sending abroad 220,000 of the 378,000 pairs exported, and in value more than one-half of the whole amount. Philadelphia, New York, and Baltimore are largely engaged in the manufacture especially of the finer qualities, and so are some of the larger towns of Maine, New Hampshire, and Connecticut. Cheaper and coarser goods are made in many of the interior cities. The aggregate value of this industry which, in 1870 was $185,000,000, in 1880 had reached $250,000,000 and more, and was, after the Flouring and Lumber interests, the greatest of all our industries.

How it grew to these vast dimensions, is a story worth the telling, and fortunately we possess all the data for telling it as it is.

As long ago as the first and second decades of the present century, there were shoe factories in many of the larger towns of New England, much after the fashion of those early ones in Lynn, of which we have already spoken, in which some shoemaker with a little capital and enterprise, purchased leather and by the offer of steady work induced ten, twenty, thirty, or fifty shoemakers, and some apprentices, to come to his shop, bringing with them their benches and kit of tools, and make up work which he could sell at the larger towns for the Southern or West India trade. These shoes were generally coarse, cowhide or kip shoes, with heavy soles, and their manufacture did not require a high degree of skill, but each man made the entire shoe himself; there was no division of labor. The best workmen disclaimed these shoe factories, and would do only fine custom-work, and some of their work was very good.

After a time, the master of the factory made patterns and cut out different sizes and styles of shoes, some of them to be bound with shoe binding, made of thin sheepskin, marked off with black and white stripes, the black to be on the outside of the shoe and the white on the inside, to correspond with the lining. These vamps and quarters were given out to his best hands to close or stitch together. This work, if sewed neatly, added to the value of the shoe. The uppers when stitched and bound were ready for the soles; and here again there was room for difference of treatment. Shoes of the better sort had a good insole, and a welt of tough but thin leather stitched neatly to the uppers, and then stitched with fine and even stitches, on the outside through the insole, welt and outsole. The wax of the waxed thread which formed these stitches was carefully cleaned so as to show how even they were, on the best work. The coarser work had its welts too, but the stitches were longer and the waxed thread larger.

The division of labor continued, and the factory-made shoes when of the best quality, were nearly, though not quite, equal to those made by good workmen to measure. Much of the factory work was of course poor and sloppy; the material inferior, and the shoes finished so as to hide defects, but not to wear. Some of the coarsest were pegged, not hob-nailed, like the English laborer or farmer's shoes, but the pegging was roughly done and the shoes were unshapely and sold only to the poorest class.

Then came the era of pegged shoes, made by the pegging machine invented about 1851 by A. C. Gallahue and subsequently improved by Townsend and Sturtevant of Boston. This machine went into extensive use in this country, and properly managed it would do very fine work, and with great rapidity. It would punch the holes, cut off and shape the pegs and drive them at the rate of 14 per second, and would peg two pair of women's shoes a minute, putting in two rows of pegs if required. About 1,700 of these machines were in use as late as 1872. They were largely employed by the manufacturers who made vast quantities of cheap but neat-looking shoes, largely by convict labor. One of these manufacturers died recently, leaving a property of four or five millions, made mostly by the manufacture of these cheap pegged shoes.

But the greatest revolution which has been made in the shoe manufacture was that which followed the introduction of the McKay sole-sewing machine, perfected in 1864. We have already explained that all sewed shoes of good quality were sewed on the outside and the soles attached to the uppers through the medium of a *welt*. The pegged shoes could dispense with the welt, but pegged shoes even at their best estate were not the choice of those who were delicately reared. A sewed shoe without a welt was deemed an impossibility, because all shoes except the light slippers, which were turned, must be, it was believed, sewed from the outside. In 1858, Lyman R. Blake, of Abington, took the first step toward solving this great difficulty, by patenting a machine which, working inside the shoe from a horn or arm, took the stitches directly through the insole, the edge of the upper, and the outsole without the insertion of any welt. There were, however, defects in this machine; it had no guiding seam channel, and it required the use of a steam chest for heating the shoes to allow the waxed thread to pass easily. Only the coarser grades of shoes could be manufactured with it. In 1860, Mr. Gordon McKay, a Boston engineer, having examined this machine carefully, became convinced that it could be perfected to meet every want. He induced Blake to take out fresh patents, one covering the machine-made shoe itself as a new article of manufacture, and another covering the process of making; both independent of the original patent on the mechanical structure. He then bought up the invention for $8,000, renamed it the McKay Sole-sewing Machine, and set about its improvement. He spent large sums of money in this direction, but it was not until two years later that he obtained from Mr. H. Mathies of Boston, an ingenious patent for channeling the leather as in hand sewing. At first he paid only $300 for this valuable invention; but later, on the urgent representation of the inventor, he paid him $10,500 more. His difficulties were not all surmounted, however, till 1864, when Mr. Blake devised a means of heating the horn from an alcohol lamp placed inside it, and by the radiation of the heat the wax on the thread was caused to soften as it passed through, and the machine was rendered available for sewing shoes of the finest quality. This contrivance was patented jointly by Blake and McKay. The machine thus improved, was taken in charge by a company styled The McKay Sole-sewing Machine Association, and Gordon McKay became its head and front and general manager. The details of its making were still further improved, and when it was fairly introduced to the trade $130,000 had been expended on it. It was soon found that every manufacturer who would keep up with the times must have the machine.

McKay, true to his inherited Scotch thrift, was shrewd and peculiar in his management of this splendid invention. He never sold a machine nor the right to make one; they were always leased at merely a nominal sum, the lease stipulating that the lessee could not call in question the royalties of the association. As he had patented the machine-made shoe, he could control absolutely every shoe made by his machine; and he attached to all his machines an automatic register by which he could know the exact number of shoes made by it. He exacted from every manufacturer using his machines, whether he used one or a hundred of them the following royalties: half a cent a pair for children's shoes, 1 cent for misses' and youth's, 2 cents for women's and 3 cents for men's; and for this royalty he furnished the manufacturers with stamps for each amount, which they were required to attach to each pair of shoes, and the self-registering machine kept a tally which must correspond with the stamp. The sum seems small but the results were enormous: a good operator could sew from 600 to 800 pairs of shoes on a McKay machine in a day of ten hours; and some of the great manufactories at



Lynn and elsewhere had as many as 100 machines steadily at work. Over 500,000,000 pairs of shoes were made on these machines in this country between 1865 and 1880, and the association received over $10,000,000 in royalties. Their foreign patents yielded them nearly as much more, and there was the added income from the rental of the machines themselves. It should be said in justice to the association, that no monopoly was ever conducted with greater care to make its burdens as little onerous as possible. The greatest pains were taken to keep the machines everywhere in perfect order and supplied with the best and latest appliances to add to their efficiency. Some of the largest manufacturers received from the association a small interest in the stock to keep them from objecting to the royalties. About the first of August, 1881, the patents of the McKay Sole-sewing Machine expired, and henceforward the manufacturers can buy their machines of the association at a cost of $250, or to make them for themselves or order them made, when the cost will not be, it is said, more than from $75 to $100, and no further royalties to be paid.

The advantage to manufacturers in general of paying such royalties on patents may be doubtful; but in the case of the shoe manufacture it has led to these good results: an immense increase in the production, with the prices on good work fully maintained; the ability of small manufacturers to keep their position with the larger ones; a great improvement in all sewed work and the production of work superior in every respect to the best of the old custom hand-sewed work, and of a quality which will satisfy the most fastidious. There are no better shoes made anywhere than Burt's, and none which give more universal satisfaction. Of course the ordinary sewing machine has been long in use for ornamenting the uppers of the finest shoes and boots, and has produced elegant work; but the invention and use of the McKay Sole sewing Machine has produced a revolution in the trade which has expanded it four fold in fifteen years, enabled us to export fine work, and made us the best shod nation in the world. There is still a market, as there probably always will be, for the trashy, cheap work, made up from flimsy and refuse material; but that market is driven down every year to a lower class; a class who cannot understand that a pair of shoes at six dollars, or of boots at eight to twelve, may be cheaper in the end than a pair at from $1.50 to $3.00, because they will outwear five or six of the cheaper pairs, and will look well to the end.

There have been numerous lasting machines invented in the past fifteen or twenty years, working with more or less success, none of which seemed to attain a good degree of perfection, but there are now two machines which appear to be all that can be desired for the purpose, the McKay for heavy pegged and nail work, the Thompson for fine sewed work. These are combined in one company under the name of the McKay & Thompson Consolidated Lasting Machine Co., which is divided into 150,000 shares. The company controls some sixty to seventy letters patent, some of which were bought of other parties having patents covering points of more or less value. We understand that either of these machines will turn out 500 pairs per day against 50 pairs per day by one man, hand work. Mr. Thompson has a staple machine to fasten the uppers to the inner sole for sewed work. There have been over $500,000 in cash and sixteen years' labor spent in bringing these machines to their present state of perfection, which promise great results, if not equal to the sewing machine.

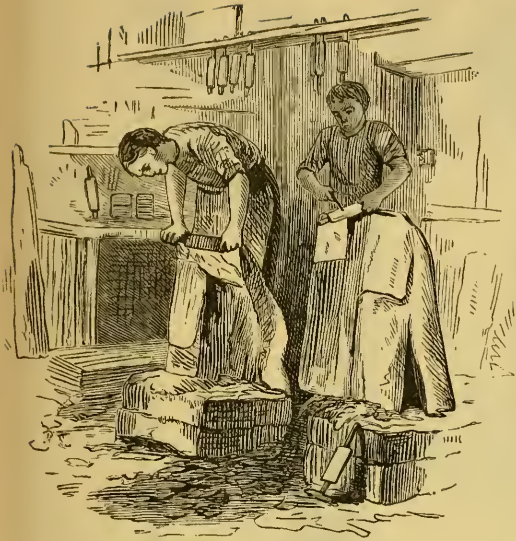
The style of making boots and shoes changes in some degree, and is leading manufacturers to introduce improvements, like that of a steel shank, so called, which is a steel spring fixed firmly in the heel, and extending under the hollow of the foot between the soles, to give elasticity to the step. The grades of city work vary with the quality of the material and the labor bestowed. The patent leather custom-made boots command $16 per pair; and the high Russia leather Wellington boots $14; and so down to $12, $10, and $9 for calf-skin; with lower rates for split leather and ordinary material. The scarcity of material, and the high prices of stock, have driven the poorer class of shoemakers to the use of old tops, or upper leathers, for both boots and shoes. These are not only refooted for the use of the wearer, but are cut down to make new shoes and boots of a smaller size. Many take much pains to buy up old articles of that description, and reproduce them at rates far below what they could be afforded by regular shoemakers from new stocks. Much art is used also in economizing the soles of cheap goods. A thin under-sole is used; between which and the in-sole, pasteboard, old slips of leather, and other cheap substances, are inserted to give an appearance of substance. These cheap varieties of shoes supply the wants of those whose means are small, with a semblance of shoeing.

The phrase, "paper soles," is not unfrequently used to designate the extremely thin substance attached to the casings of the dainty little feet of our fair sex, but still that substance is leather. Recently, however, a pair of veritable paper soles were put upon a customer, and worn, though for a very limited time. The victim in the case was a strapping negro fellow, who, allured by the seductive invitation to "walk in and see the cheap clodings," entered a Jew's museum, and purchased a pair of laced boots for $1.50.

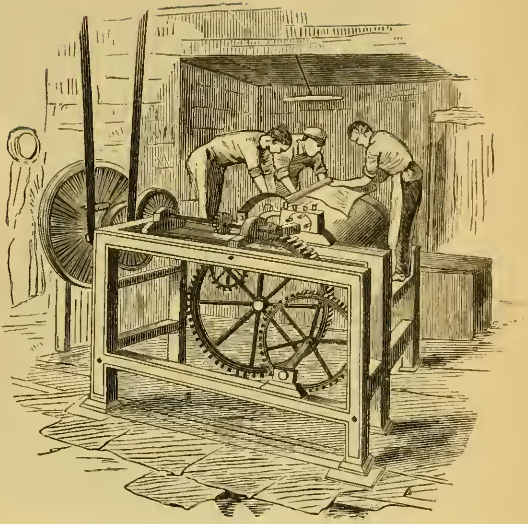
They fitted well, and wore well for a few hours, but great was his astonishment when his trotters parted company with his boots, and he was once again barefooted. On examining more closely his purchase, he found that the soles were composed of thick paper board, colored to resemble leather, and pegged to the uppers. The sympathizing justice heard his complaint, but could grant no relief.

The Bureau of Statistics of Labor, in Massachusetts, reported, in 1878, the following statistics of leather and manufactures of leather in that state. They are very incomplete, for there is no report of saddlery and harness, leather belting, trunks and portmanteaus, fire hose, carriage tops and boots, enamelled leather, morocco, pocketbooks, satchels, and fancy leather goods, razor strops, etc., etc., but imperfect as they are, they show an amount of products in a single line of industry surpassed by no other state.

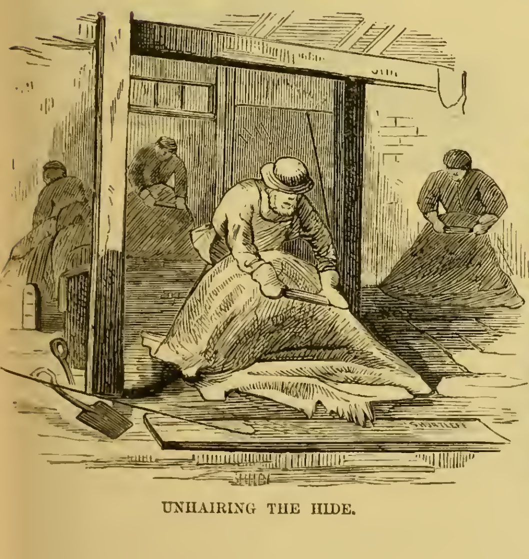
| | Establishments. | Persons Employed. | Capital Invested. | Materials used. | Wages paid. | Goods produced. |
|---|---|---|---|---|---|---|
| | | | $ | $ | $ | $ |
| Boots & Shoes, | 1,461 | 48,090 | 18,692,864 | 54,976,504 | 21,883,354 | 89,375,792 |
| Leather, | 495 | 6,620 | 8,399,850 | 16,108,845 | 3,901,033 | 23,680,775 |
| Whips, | 54 | 626 | 615,630 | 384,009 | 297,458 | 922,096 |
| Miscellaneous. | 10 | 230 | 240,142 | 200,000 | 86,252 | 419,061 |
| Totals, | 2,020 | 55,566 | 27,948,486 | 71,467,358 | 26,167,697 | 114,397,724 |



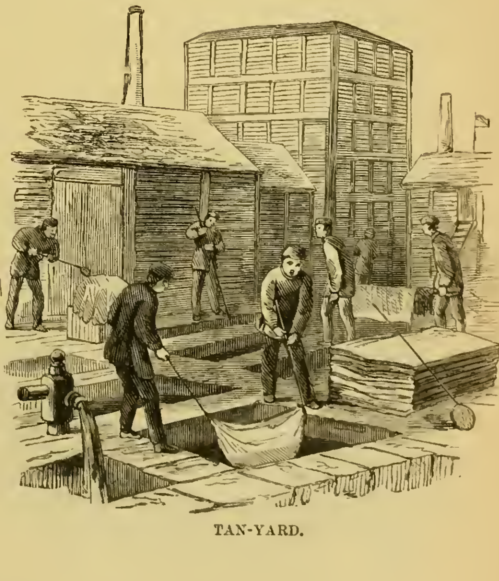
OVER THE BEAM.
Shaving the fleshy matter from the hide.



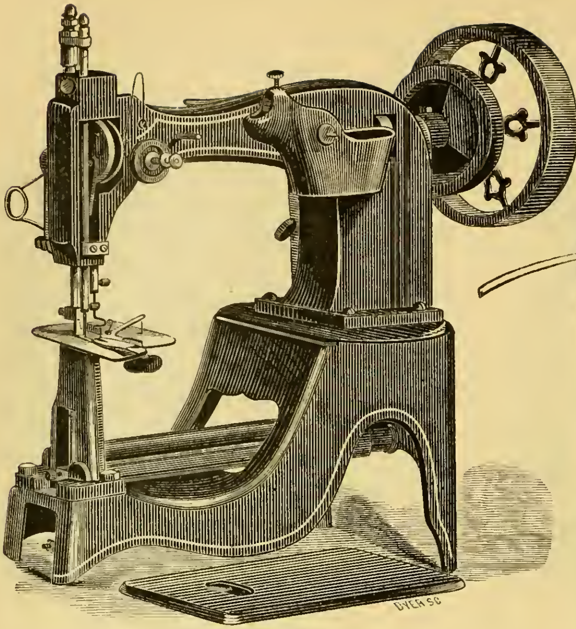
HIDE-SPLITTING MACHINE



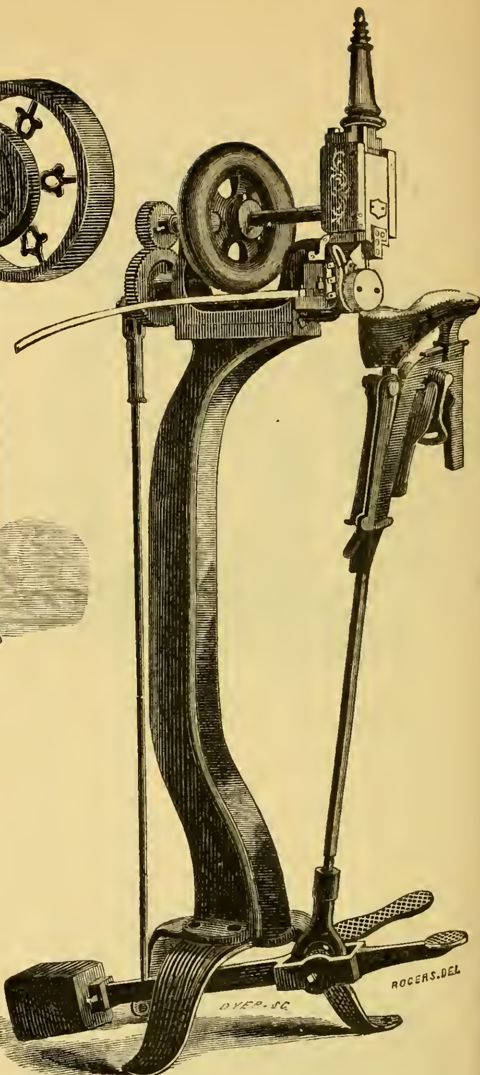
UNHAIRING THE HIDE.



TAN-YARD.




WAX-END SEWING MACHINE.




PEGGING MACHINE.


PEGGING BOOTS BY HAND.

From 250 to 500 pairs per day are done by the machines, according to the kind of machine, and whether run by hand or power. Improvement fifteen or twenty to one.

The manufacture of gloves has not extended itself in this country so much as some other industries, with the exception of buckskin gloves, which are peculiarly American, combining utility with dress. The use of gloves is becoming far more general in cities than formerly. In early times, the practice of presenting a pair of gloves at funerals to the attending clergy and others was carried to such an extent in Massachusetts that the legislature forbade the practice, under a penalty of £20. The presentation of gloves to the pallbearers at funerals is still very general, both in this country and Great Britain.

The materials of which gloves are made are of leather, fur, cloth, and knitted goods of wool, silk, worsted, linen, and cotton thread (the Lisle thread gloves being of sea-island cotton), and to a small extent of ramie. India rubber is also used for gloves for some purposes. Of leather and fur, which are the materials most largely employed, there is a great variety. Doe, buck, and calfskin, are most used for heavy gloves; seal, otter, and reindeer skin, for fur gloves; sheepskin and dogskin for military gloves; lambskin, of which so much so-called kid is manufactured; kangaroo, and perhaps to a small extent rat skins, for the thumbs of the finest gloves, and genuine kid of which the best qualities of kid gloves are made. There is a very general opinion that rat skins are the principal material of the finest French gloves; but as a matter of fact, very few are used, the skin of the rat being less even in texture, cutting to less advantage, and being less uniform in supply than the skins of the young kids, killed before they have begun to crop herbage. Great numbers of these are reared for this special trade in France, Italy, Switzerland, Ireland, Cape Colony, and the East Indies. The preparation of these skins for the finest gloves is a long, difficult, and delicate process. More than 2,000,000 dozen pairs of kid gloves are made in France alone, besides large quantities in Italy, Belgium, Sweden, Denmark, and Germany. These all require about 500,000 dozen kid skins. The English leather gloves are generally of a heavier quality, and are made from calf or reindeer skin, or the skins of larger animals.

The chief seats of the French glove manufacture are Grenoble (which produces nearly one-half of all that are made in France), Chaumont, Milhau, and Niort. At least two-thirds (more than 17,000,000 pairs) of the gloves made in France are exported.

Our importation of gloves, in 1880, was 663,813 dozen pairs invoiced here at $3,-670,525, without the duty, and probably worth on the market over $7,000,000. This was about the average importation of the last ten years. Of these, about 250,000 dozen pairs were from France, invoiced at $1,629,064; about 290,000 dozen from Germany, invoiced at $1,345,542, and 114,974 dozen from England, invoiced at $662,107. The importations from all other countries amounted to less than 10,000 dozen pairs.

There are no later statistics of the amount of the glove manufacture of the United States than those of the census of 1870, even the preliminary report on the subject for 1880 not being yet ready. We give, therefore, the figures of 1870, which show 221 establishments, of which 144 were in the state of New York. 4,058 hands employed, of whom 3,112 were in New York. Of these 4,058 hands, 1,127 were men, 2,894 women, and 37 youths. The amount of capital employed was $2,-340,550; the wages paid, $980,549; the raw material used was valued at $1,884,-146, and the value of goods produced, $3,-998,521, of which $3,507,795 was credited to New York. It is safe to say that within the decade the number of establishments, and probably the amount of products, in New York have more than doubled, and largely in the direction of kid, lambskin, and dogskin gloves. In many of the qualities the American product is equal to the imported. In the finest qualities of kid gloves it is not yet, but is improving. For many years past, buckskin gloves and mittens, and other heavy gloves for driving and military use, as well as the delicate wash leather gloves for ladies' use, have been made in annually increasing quantities at Gloversville and adjacent places in Fulton Co., New York. In 1860, nearly a million dollars worth of these gloves were produced in Fulton County; in 1865, notwithstanding the war, it had increased to $1,187,686, and in 1870 it had taken a new impulse and gone up to $3,189,920, considerably more than three-fourths of the entire manufacture in the United States. The past decade will unquestionably show a very large increase in this particular industry, and will go far to make Gloversville the Grenoble of America.

For many years, the great reputation of French kid gloves rested quite as much on the delicacy and fine quality of the material, and the perfection of the colors, as upon any excellence in their manufacture. They were cut, we may say, by guess, with long scissors, one pair at a time, and he was the most skillful cutter who could make the greatest number of pairs out of a single skin. The skins were from their treatment elastic, and it was possible, by stretching, to make a considerable difference in the quantity produced from a single skin. In 1819, Vallet d'Artois, a French glove manufacturer, invented punches in three different sizes, each punch capable of cutting out two dozen pairs at once. The conception was an ingenious one, but of little practical value, inasmuch as it did not make allowance for the lateral and longitudinal extension of the leather. In 1834, Xavier Jouvin, a young French glove maker of great ingenuity, and a very thorough knowledge of practical geometry, commenced the study of the human hand with reference to its incasement in kid gloves. He set to work on a strictly scientific basis; first to classify the various sizes and forms of the hand; next to determine the exact stretch of leather required to cover each of them; then to draw up a list or scale, in which by means of a letter and a figure the glove-wearer should find the exact size and shape of his own hand. By an ingenious application of certain geometrical rules, he succeeded in ascertaining the amount of any quality of kid required for any sized glove. He found that 32 sizes included all dimensions of hands, the various shapes of which he classed under five heads: very slender, slender, medium, broad, very broad. Having divided each type into two dimensions, he got ten distinct glove forms, and multiplying these by the original 32 sizes, obtained 320 different numbers of gloves; a more than sufficient variety. many numbers being very seldom required. For each of the 32 sizes he made a *calibre* or glove pattern of sheet-iron, furnished on its inferior surface with diminutive points for marking upon the kid the place for the thumb hole, and the lines for embroidery on the back of the hand. He also made small calibres for the thumbs, and punches for cutting the thumb-hole and shaping the gussets. A piece of kid having been duly stretched, the calibre was pressed upon it, and it was cut to the shape of the pattern by means of a knife invented for the purpose. In 1838, he replaced the calibres with punches, which cut out at once the glove, thumb-hole, button-hole, and cleft at the wrist, and traced the three rows for embroidery. These punches (which are still in use in the Jouvin manufactory) are forced by a lever through several layers of kid, and thus cut out a number of gloves at a time. But the most ingenious thing in his process was his contrivance for cutting out with the same punch gloves for differently formed hands. For this purpose he used skins varying in elasticity, which he classified carefully. To this day, all the genuine Jouvin gloves bear two marks, one indicating the number of punch with which they were cut, and the other the degree of elasticity of the leather. Subsequent modifications were made in the punches, one of them, we believe, for cutting the thumb as a part of the glove, but the Jouvin patents have controlled the glove manufacture in France, and have added very largely to the sales of French kid gloves. Xavier Jouvin has passed away, but his manufactory still maintains its reputation for excellent work.

Some of our later manufactories of gloves in this country have professed to adopt the Jouvin system, but either their material is not so good, or they do not classify the skins so carefully. The sewing of the finest qualities of kid gloves is a very delicate business, as the least stretching or the use of too coarse a needle may render the glove worthless. For this sewing a machine of English invention is generally used. It consists of an iron vice, set in a stand which is screwed to the edge of a table. Each jaw of the vice has its extremity made of brass, and is tipped with a comb of the same metal, the teeth of which, about one-twelfth of an inch long, are perfectly even and regular. The spaces between the teeth, as also the shape of the comb, vary according to the kind of sewing required; therefore, sets of vices are used provided with combs of different shapes and sizes. One jaw of the vice is made fast to its stand, but the other is movable by a hinge, and is kept in its place by a strong spring. The movable jaw is furnished with a lever connected by a wire with a pedal, upon which the workwoman presses her foot when it is necessary to separate the jaws. She inserts the seam to be sewed between the two brass combs, then lifts her foot, and the jaws, closing firmly upon the kid, hold it in position. She then passes her needle successively through all the teeth of the comb, and is sure to make an even seam if she lets it graze along the bottom of each notch. When one piece is sown, she again presses the pedal, and repeats the above process with a fresh seam. The glove-sewer usually begins by putting in the thumb with its gusset; she then sews the long seam from the wrist to the tip of the little finger, puts in the finger gussets, and sews the fingers. Some varieties of gloves do not have this long seam. We think the ingenuity which devised and perfected the McKay sole-sewing machine might devise a machine which should sew these gloves as perfectly as they are sown by hand, and with twenty times the rapidity. Automatic machines are a specialty of American inventors, and there was never a better opportunity for one than this. But to return to the French glove. When it is sown, the slit at the wrist is bound, the button-holes completed, buttons or some other fastening added, and a binding of white kid or some other finish put round the wrist. It is the rage now to wear gloves with from six to twelve buttons, sometimes extending half-way to the elbow. The glove being completed, is pressed and smoothed, the finger gussets folded back between the superior and inferior surfaces of the fingers, and the thumb bent across the palm.

The old proverb, "There's nothing like leather," seems to hold good yet, though great and partially successful efforts have been made to substitute other materials and combinations for it. The most noticeable of these have been the "Pannus Corium," a composition kept secret, and now but little used; the hemp or flax leather, which by combination with certain resins makes a tolerable substitute for sole-leather; the artificial leather, which by chemical and mechanical processes is transformed from old leathern scraps into a homogeneous material, and the modern preparations of *papier-mache*, which possesses the lightness, durability, and imperviousness to moisture of leather itself. The Lineolum or flax oil-cloth, in some of its forms, also makes a fair substitute for leather, as do some of the preparations of India-rubber and gutta-percha. But, after all, for many of the purposes for which it is indispensable it is still true, that "there's nothing like leather."

# FIRE-ARMS.

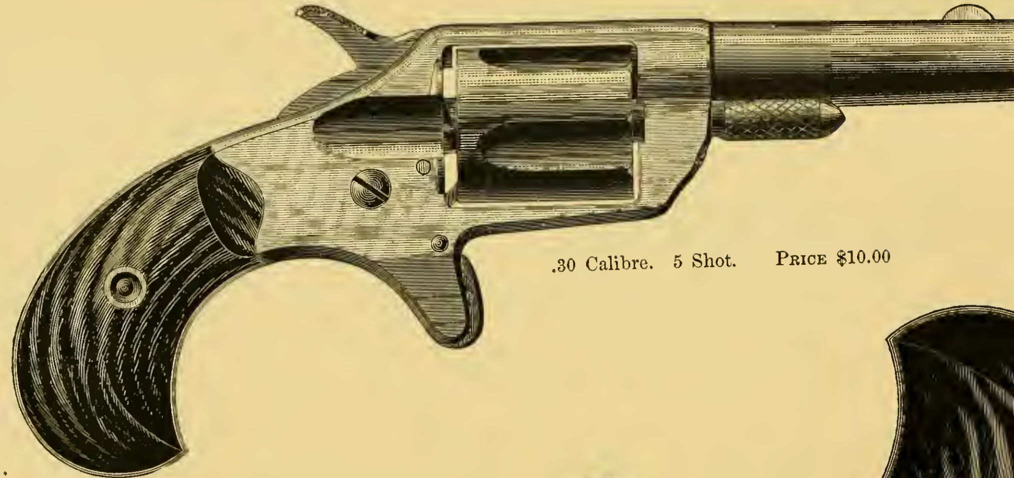
## CHAPTER I.

### COLT'S REVOLVERS — SHARP'S RIFLES — DAHLGREN'S GUNS.

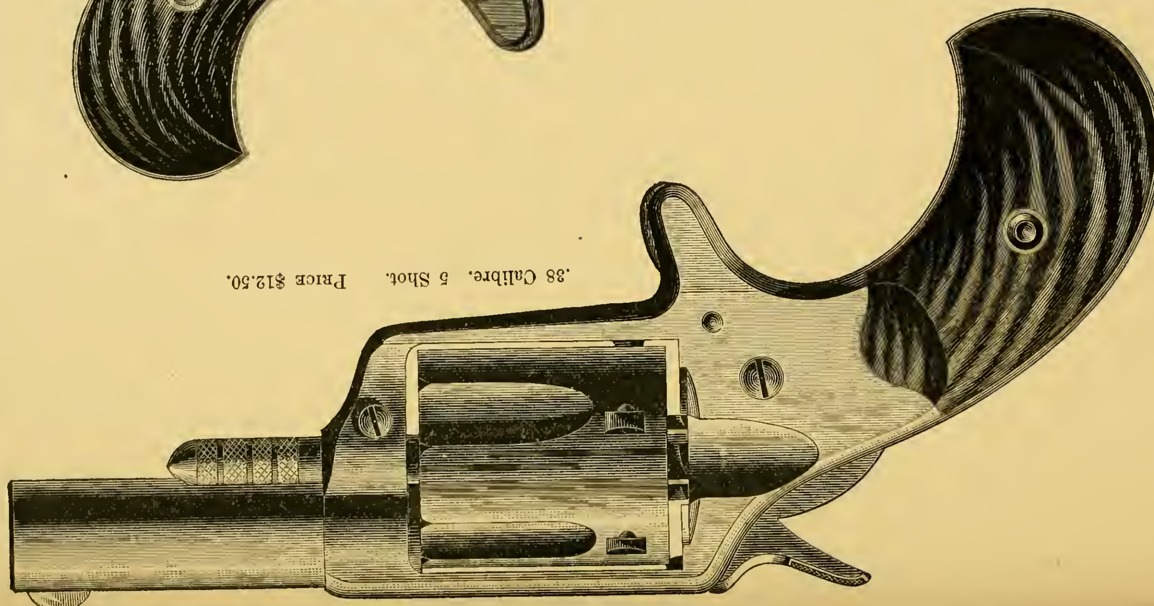
The improvements in fire-arms are making such rapid progress among civilized nations, that we may indulge the hope that they will soon cease to be wanted at all; since, as extremes meet, they may become so effectual in their operation, and war reduced to such a science, that an attempt to fight will only be entire mutual destruction, like that most effectual combat between the two Kilkenny cats. The war of 1866 in Europe, in which Prussia, in seven weeks, broke the power of Austria, is an example of the force that may now be exerted in a short space of time, and the newly-invented needle-gun had a powerful agency in bringing matters to a close. After the invention of gunpowder in the fourteenth century, the art of gunnery made great progress, and the musket came to be the most important weapon. The Roman legions used the short stabbing sword as their favorite weapon. In the age of chivalry, the lance of the horseman was the queen of weapons, and continued so up to the battle of Pavia, in 1525, when chivalry made its last charge, and went down with the white *panache* of the gallant Francis I. From that time the arquebuse, then a matchlock, improved into a firelock, displaced the English bow, acquired the bayonet, and became, in its turn, the "queen of weapons." When the musket, or "Brown Bess," was furnished with percussion caps instead of flints, and the sword bayonet was added, there seemed to be little to hope for in the way of improvement. Since the "wars of the Roses" in England, nine-tenths of all the battles of the world have been decided by projectiles, artillery, and musketry, without crossing a bayonet or drawing a sword. The cavalry, as an arm, has continually lost ground, except in the rout of a defeat, when it follows up a flying enemy. It never could break a square, even when armed only with pikes, and recent events have shown that it cannot reach infantry in line.

A remarkable change has come over "Brown Bess" of late, and it seems now to have seen its best days. The rifle, or a screwed barrel, was among the first forms of the manufacture of small arms in the sixteenth century; but the musket was preferred, on account of its more speedy loading. The rifle was, however, the favorite with the American colonists, and its execution in their hands during the Revolution brought it into general notice. The adding of the percussion cap was a great improvement to it. Recently it has become so improved as to supplant not only the old musket, but artillery also, since the events of the last few years have shown that it is easy to silence cannon by shooting down the gunners at their pieces, beyond the reach of grape. In the text-book of the St. Cyr Military School of France, it is directed that the fire of artillery should cease when the enemy is distant twelve hundred yards. At Waterloo, the opposing armies being twelve hundred yards distant, were out of reach of all but solid shot from field guns, as they were then served. It is now stated that the Minié rifle is effective at a mile distant, and at two thousand yards troops can easily shoot each other. It follows, from these simple facts, that artillery must improve or become ineffective. The improvements in the rifle were mostly in the ball. The French pin rifle had a small steel "pin" in the bottom of the chamber. The powder filled in around this pin, and the ball, of a conical shape, hollow at the base like a thimble, had a small metal plate, which, on being rammed home, struck against the pin, and spread the ball so as to slug the piece. The Minié rifle was nearly the same, without the pin, because it was found that the explosion would of itself spread the ball. The performances of this weapon are somewhat marvellous, since it is

COLT'S NEW BREECH LOADERS.

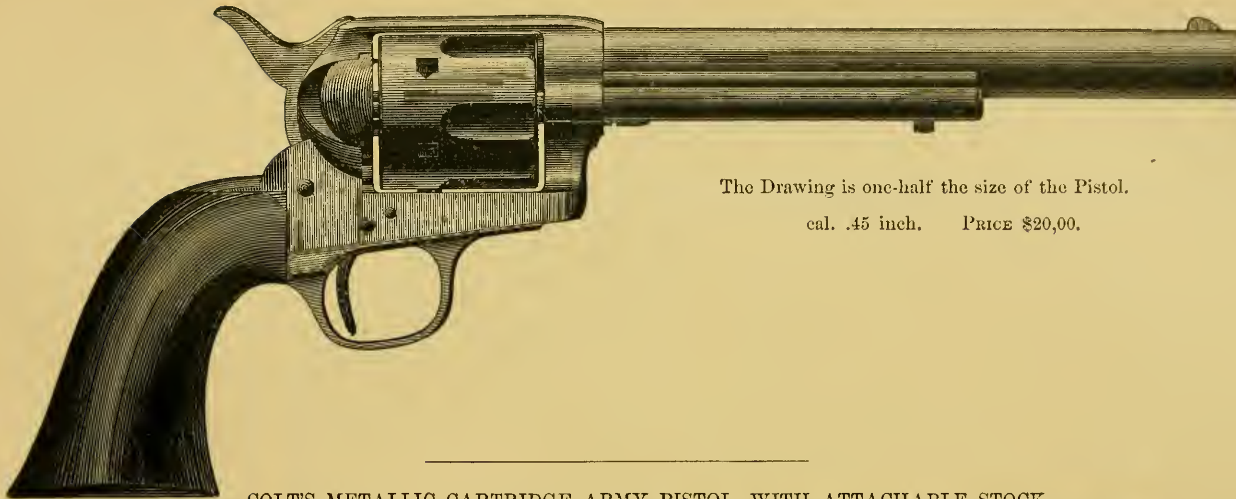


.30 Calibre. 5 Shot. Price $10.00



.38 Calibre. 5 Shot. Price $12.50.

COLT'S NEW MODEL ARMY METALLIC CARTRIDGE REVOLVING PISTOL.



The Drawing is one-half the size of the Pistol.

cal. .45 inch.   PRICE $20,00.

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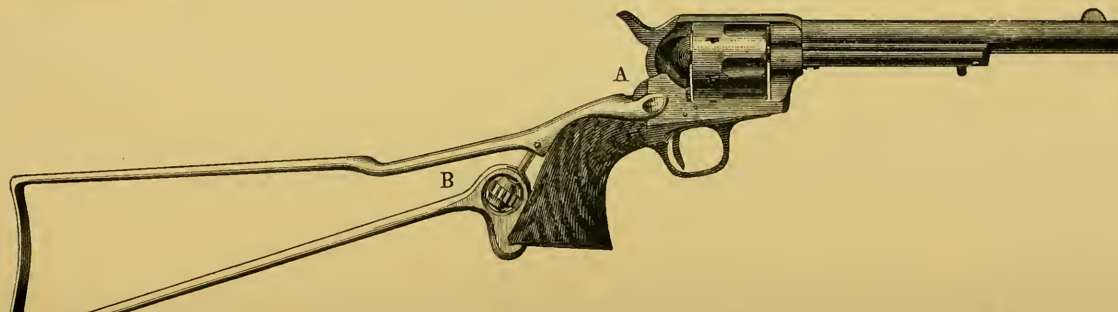
COLT'S METALLIC CARTRIDGE ARMY PISTOL, WITH ATTACHABLE STOCK.




This Attachable Stock is made of gun metal, nickel-plated, and can be fitted to any of the .45 cal. Colt's Army Pistols.

said that it is effective at a distance of over a mile.

The most important improvement in small arms has, however, been in repeating weapons, of which the revolvers of Mr. Samuel Colt are the type. Mr. Colt was a seaman in his youth, and while on a voyage to Calcutta devised the revolver. He made the model in wood, in 1829, while at sea. Improving upon this, he took out his first patent for fire-arms in 1835. This was for the rotating chambered breech. This of itself was no new invention, since many of the old arms preserved in the tower of London have the same style of manufacture. It is obvious, however, that what is possible in this respect with percussion caps, was not so with the old flint-lock. Mr. Colt had the advantage of the cap, and his invention caused the chambers to revolve by the act of cocking. In 1851, he read an essay upon the subject before the Institution of Engineers in London. Patents were issued in France, England, and the United States; and in 1835 an armory was established at Paterson, N. J., but afterward abandoned. The first important use made of this new arm was in 1837, by the United States troops under Lieut. Col. (now Gen.) Harney. The Indians were acquainted with a "one-fire" piece, but when they saw the troopers fire six times without loading, they thought it time to give in. There was not much demand for the arm until the Mexican war of 1846–47, when a supply was required for Taylor's army. The government ordered 1,000, and there was not a model to be found. This order was filled at Whitneyville, near New Haven. Other orders followed, and the works were transferred to Hartford. Mr. Colt manufactured on his own account. The California fever set in, and was followed by the Australian excitement. The demand for arms thus occasioned, induced Colonel Colt to erect an armory unequalled in the world. It occupies what was a flooded meadow of two hundred and fifty acres. This is diked in for two miles, and the most extensive buildings have been erected, at a cost of $1,000,000, to supply 1,000 fire-arms per day. In 1858, 60,000 were turned out. All the accessories of these arms—balls, cartridges, bullet-moulds, powder-flasks, etc.—are manufactured at this place. There are also extensive works for the manufacture of the machinery by which fire-arms are made. It is to be remarked that at these works the machinery for the British government armory at Enfield has been made; and also all those for the Russian government at Tula. The arms of Colt attracted great attention at the World's Fair of London. "In whatever aspect the different observers viewed the American repeaters," says an account of the impression they made at the Crystal Palace, "all agreed that perfection had been reached in the art of destruction. None were more astonished than the English, to find themselves so far surpassed in an art which they had studied and practiced for centuries, by a nation whose existence was within the memory of man, and whose greatest triumphs had been in the paths of peaceful industry. The Duke of Wellington was found often in the American department, pointing out the great advantage of these repeaters to other officers and his friends; and the different scientific as well as popular journals of the country united in one common tribute of praise to the ingenuity and genius of Colonel Colt. The Institute of Civil Engineers, one of the most highly scientific and practical boards of its kind in the world, invited Colonel Colt to read a paper before its members upon the subject of these arms, and two of its meetings were occupied in hearing him, and in discussing the merits of his invention." He was the first American inventor who was ever thus complimented by this celebrated institute, and he received at its hands, for his highly able and interesting paper, the award of a gold medal and a life-membership. In addition to his presence before the institute, Colonel Colt, in high compliment to his experience and skill, appeared also, upon special invitation, before a select committee on small arms of the British Parliament, and there gave testimony which was gladly received, and deemed of superior practical value. His own statements were amply corroborated at the time, before the same committee, by British officers, and others, who had visited his armory in America; and especially by J. Nasmyth, the inventor of the celebrated steam hammer, who, in reply to the inquiry, what effect his visit to Colt's manufactory had upon his mind, answered: "It produced a very impressive effect, such as I shall never forget. The first impression was to humble me very considerably. I was in a manner introduced to such a skilful extension of what I knew to be correct principles, but extended in so masterly and wholesome a manner, as made me feel that we were very far behind in carrying out what we knew to be good principles. What struck me at Colonel Colt's was, that the acquaintance with correct principles had been carried out in a bold, ingenious way, and they had been pushed to their full extent; and the result was the attainment of perfection and economy, such as I had never met with before." All tests and examinations to which the repeating arms were subjected in England, were highly in their favor. Emphatically they spoke for themselves. The enormous power—nay, the invincibility of British troops armed with them, was demonstrated. "The revolver manufactured by Colonel Colt," said the *Dover Telegraph*, a public journal, expressing the best and almost universal opinion of England upon the arm, "is a weapon that cannot be improved upon. It will, we unhesitatingly predict, prove a panacea for the ills we have so unhappily encountered in the southern hemisphere. The Caffre hordes will bitterly rue the day on which the first terrific discharge is poured upon their sable masses." And so a panacea the revolver did prove, both with the Caffre hordes, and with the Muscovite also, upon the bloody plains of the Crimea. Over 40,000 of these pistols are now in use in the British navy; and Garibaldi has been ably sustained by a corps commanded by Colonel Peard, and armed with Colt's revolving rifles.

The most important progress in the manufacture of these arms, is that each separate part of a pistol or carbine is made after one pattern by machinery, and with such entire accuracy, that a number of the weapons may be taken to pieces, and any part of one will fit any of the others. Each separate part is made perfect of itself, and separate boxes contain these parts. The weapons are put together rapidly when wanted. There has been a gradual improvement in them, from suggestions derived from their use in Mexico, the Crimea, and Italy. It is now a world-renowned weapon.

The great success of Colt has, of course, brought forth imitations, and repeating arms of many descriptions have been patented. Very many are infringements on Colt. There are Allen's, Derringer's, the Volcano, and other pistols, and Pettinger's patent, which has a revolving chamber, and also a patent lock of some reputation.

There has been for some fifteen or twenty years past a constantly-increasing predilection for breech-loading fire-arms, and especially rifles. Breech-loading guns may be divided into two general classes; those which may be loaded with loose powder and ball, or a paper, linen, or tin-foil cartridge fired with a cap or primer; and those which use a metallic cartridge having the fulminating composition in its base and fired directly by a blow of the hammer on the cartridge. One of the earliest, as well as one of the most successful of the first class is the invention of Mr. Christian Sharps, of Philadelphia, generally known as Sharps' Rifle. The barrel of this is of cast-steel, and its chamber or ball-seat is counter-bored, slightly conical, the exact shape and diameter of the conical ball, so that when it is properly forced to its seat, it has its axis exactly coincident with that of the bore. It is self-priming with Sharps' primer, but can be used with the ordinary army percussion-cap. They are made of two lengths, 24 and 30-inch barrels, and of different calibres from 0.35 in. to 0.52 inch. For military purposes this is an excellent weapon, especially for cavalry use; of sure fire, sufficiently accurate for practical purposes, capable of being fired rapidly, of long range and with high-penetrating power. For sporting purposes it is surpassed in accuracy, especially at long range, by two or three other guns.

The "Merrill" rifle is another breech-loader, using the paper cartridge and the ordinary percussion cap, and so simple in construction, that muzzle-loading arms can be changed to breech-loaders on its plan with but small expense and without alteration of their appearance or strength. It is of long range, easily and rapidly loaded, and accurate in its fire.

"Greene's rifle," invented in 1857 by Lieut. Col. J. Durell Greene, U. S. A., is a breech-loader, admirably adapted for military use, but of different construction from either of the preceding; rifled on the Lancaster plan, *i. e.* having an elliptical barrel, with a turn of three-fourths in the length of the barrel, and no grooves. A cylinder of iron containing a breech-plug which slides backward and forward within it, is inserted at the breech of the barrel, and moved forward by a projecting knob, which moves in a slot on the top of the barrel, till it closes the breech, when it is turned to the right and secured in place by shoulders. The knob is held by a catch, which may be loosened by pressing a pin at the breech of the barrel. The hammer is on the under side, in front of the guard, and the nipple is so arranged that the fire is first communicated at the forward end of the cartridge, thus insuring the ignition of all the powder. The cartridge has the bullet in its base, with a greased wad between it and the powder, which, with the bullet, packs the joint perfectly at every discharge, and prevents the slightest escape of gas. After each discharge this bullet is pushed forward by the breech-plug to the end of the chamber, the cylinder is then drawn back, and the cartridge inserted in the slot which is thus opened. The cylinder is then pushed forward, pressing the cartridge before it, and the knob being turned to the side and the nipple capped, the gun is ready to fire. The construction and movement are perfectly simple, and the gun is well adapted for rough usage.

The "Maynard rifle" is a great favorite with sportsmen and almost equally so with army officers. It was invented in 1851, but has been somewhat improved in form and some of its minor details since. Its mechanism is very simple, but wonderfully ingenious. The barrel is attached very firmly to the stock, yet the removal of a single pin disconnects it, and the whole gun, with all its attachments and a supply of extras in case of necessity may be packed in a space 20 inches by 6, and one inch deep. Its penetrating power, though sufficient for all ordinary purposes, is not quite equal to that of the Colt, Spencer, Greene, or Sharps, but its range is as great as either and its accuracy superior to almost any other. It is ordinarily used with a metallic cartridge very well made, and which is capable of remarkable execution, but these cartridges when empty can be filled by the rifleman expeditiously, or by the use of a charger, always accompanying the rifle, loose powder and ball may be used. Instead of a percussion cap, Dr. Maynard's primer, a narrow strip of varnished paper of double thickness, having deposits of fulminating powder in equi-distant cells between the thicknesses of the paper, three dozen of which are coiled in a magazine concealed beneath the lock-plate, and brought up by a wheel in the act of cocking; the fall of the hammer explodes the cell and cuts off the paper behind it. Of 250 shots fired with this rifle at a distance of 500 yards (1,500 feet,) 214 struck within a space 5 ft. by 5 ft. on the target, and 40 within a circle 2 ft. in diameter.

The rifles using a self-exploding metallic cartridge may be divided into two classes; those loaded with a single cartridge and requiring to be recharged for every shot; and those having a magazine and arrangement for repeating their fire without reloading. Of the first class, two weapons have attained a deserved reputation, F. Wesson's breech-loading rifle, and the "Ballard rifle." The Wesson rifle is well made, accurate, has a long range and a fair penetrating power. It lacks an arrangement for throwing out the empty cartridge after firing, if it adheres, as it sometimes does. The firing both by this and the Ballard are quite rapid, the motions for reloading being few and simple.

The "Ballard rifle" has a good reputation. It is simple in its construction, of somewhat less initial velocity and penetrating power than the Wesson, but sufficient in both for all practical purposes. The ordinary military rifle of this pattern is so arranged that it can be used at will either with the metallic cartridge or the ordinary soldier's cartridge fired with a percussion cap. When the metallic cartridge is used, there is a finger piece under the barrel which throws out the empty cartridge.

Of the repeating rifles, there are two, beside Colt's, which is constructed on the same general principle as his pistols. It is a very effective weapon, and is much liked by sportsmen for hunting large game. Like all the Colt weapons, these are manufactured with great care and are surpassed by none in the world in the perfection and exactness of their finish. The other two best known repeating rifles are on entirely different principles, and during the war and since, have won a very high reputation.

The Spencer repeating rifle was patented in the United States in March, 1860, and in Europe the same year. While a breech-loader, it repeats its fire seven times, having a magazine with a double sheathing of metal located in the butt of the gun, and thrown forward into the barrel by springs so rapidly and unerringly that if there is a single cartridge in the magazine it never misses fire, and an ordinarily skilled marksman can discharge the seven loads in twelve seconds. Its range is enormous. It will throw a ball with fair accuracy two thousand yards, (over a mile,) and at a distance of one hundred and fifty feet will penetrate through 13 inches of timber, and at the same number of yards will penetrate over 10 inches. Its charge of powder is but little more than half the U. S. regulation charge. In the war this rifle did terrible execution; at Ball's Bluff one regiment of the confederates were armed with it, and to them was due the frightful slaughter of that bloody field. At Gettysburg, where a part of Gen. Geary's troops were armed with the Spencer, the attack on them by a division of Ewell's (shortly before Stonewall Jackson's) Corps on the night of the 2d of July, was repulsed by a greatly inferior force with terrific destruction of life. An eye-witness said of it, that "the head of the column, as it was pushed on by those behind, appeared to melt away or sink into the earth, for though continually moving it got no nearer." In the western army the same result followed its use; a régiment armed with it being a match for a division with the ordinary Springfield musket.

"Henry's repeating rifle" is also a very formidable weapon. Its magazine, a metal tube on the under side of the barrel, contains fifteen metallic cartridges, and is opened for their admission and propulsion by a ring or sleeve, also of metal, which turns upon the barrel, and is connected by a spring with the carrier-block, and each cartridge in turn placed on this and raised to the level of the chamber by the action of cocking the gun, when a reverse movement of the guard forces it into the chamber ready for firing. The fifteen shots can be fired in less than eleven seconds, and 120 shots in 5 minutes and 45 seconds, including the time spent in recharging the magazine. The magazine is in some danger of being bent or battered by a chance shot in battle, so as not to deliver its cartridges promptly, and while the "sleeve" at the muzzle interferes with its value for sporting purposes, it, and its European improvement, the Martini-Henry rifle, are among the best army weapons in existence.

The unrifled musket as a military arm is now abandoned. Three military commissions were called, in 1866, 1869, and 1872, presided over respectively by Gen. Hancock, Gen. Schofield, and Gen. Terry, to determine what was the best form, model, and calibre for rifles for army service, and whether the arm should be breech-loading or muzzle-loading. The first commission examined 22 varieties of breech-loading muskets and 17 varieties of breech-loading carbines, and reported in favor of breech-loaders, but deemed all the patterns susceptible of further improvements. The second commission examined 34 varieties of breech-loading muskets, 8 varieties of carbines, and 8 of pistols. and recommended the Remington, Springfield, and Sharps's systems of breech loading as superior to others (in the order named) and alone suitable for adoption by the government, without further trial in the hands of troops. In 1870, muskets and carbines of each of these three systems, and also of the Ward-Burton system of magazine breech-loader were prepared and placed in the hands of companies of infantry and cavalry for comparative trial in service during a period of not less than twelve months, reports to be made regularly every month by company commanders, and at the end of the time appointed to be laid before a board of officers chosen to select a suitable breech-loading arm for adoption for the military service. Meanwhile the Springfield armory, a government institution which had made muskets of great excellence before the war, and which had in its employ some of the most accomplished machinists in the world, was exerting itself, as were its rivals, to make a rifled musket as absolutely perfect for its purposes as was possible. The third commission met in Sept., 1872, alternately at New York and Springfield; they had before them 99 varieties of American breech-loading muskets, and 9 varieties which were in use by one or more foreign nations. After eight months of careful investigation the commission reported, recommending that "the *Springfield breech-loading* system be adopted for the military service." The recommendation was approved, and all United States troops are supplied with these arms. The wisdom of this selection is now generally conceded. The following is the description of the Springfield model. The barrel is of "low steel" (Bessemer or other), calibre 45 ins., rifled with three concentric grooves of equal widths with the bands, and of uniform depth of .005 of an inch, and uniform twist of one complete turn in 22 inches. The lock-plate is 0.175 inch thick, and let in flush. The exterior metal-work is browned (except the bayonet). An open swivel is attached to the Merrill upper-band for stacking arms, instead of locking bayonets as heretofore; also, a "trowel-bayonet" and "intrenching tool" proposed. Length of rifle barrel, including receiver, 36 inches; of the carbine, 25.4 inches. Length of rifle bayonet 18 inches; crook of stock, 2½ inches, and distance from butt to trigger, 13½ inches. Total length of rifle, without bayonet, 51.9 inches; of carbine, 41.3 ins.; weight of rifle, without bayonet, 8.38 lbs.; of carbine, 6.87 lbs. Triggers adjusted to pull at six to eight pounds. As in all the best small arms, all the parts are interchangeable.

*Details of practice: Rapidity of fire*, using service cartridge box, 12 to 13 times per minute; a very skillful expert has fired 23 times per minute. *Drift*, or deflection of the projectile to the right, for the rifle at 500 yards is 25 inches. Initial velocity of rifle-ball, with 70 grains of powder, 1,350 feet; of carbine ball, with 55 grains of powder, 1,100 feet. Pressure per square inch, 19,000 pounds. Force of recoil with rifle with service charge, 174 pounds; of carbine with service charge, 155 pounds; of carbine with rifle charge, 182 pounds. Penetration into white pine (one inch corresponds in force with that producing dangerous wounds upon the body), with the rifle at 100 yards, 17.2 inches; with the carbine, 14.5 inches; with the rifle at 1,200 yards, 3.7 inches, a range sufficient to make it a most formidable weapon. Its penetrating power at 1,200 yards, almost three-fourths of a mile, is sufficient to produce a fatal wound. The Cadet rifle, also made at Springfield, is a little shorter and lighter than the infantry rifle musket.

It is worthy of notice that several of the European governments, though of course they do not adopt our Springfield rifle, have yet adopted those invented by American mechanics. This is especially the case with Great Britain, which in its Martini-Henry has taken up with a modification of our Henry rifle. Turkey adopts the same, and, moreover, has most of its rifles made here; Spain has adopted the Remington system, and Denmark and Sweden have followed her example. Most of these are made here. Russia has the Berdan rifle, but, we believe, now manufactures it at home. Most of the European governments use the Colt's revolvers, as does our own army in part, the Schofield, Smith & Wesson, and the Remington revolvers being its only competitors.

The lapse of twelve years since a part of this article was written has necessarily brought about some changes in small arms not intended exclusively for military use, as well as in those which are. Col. Colt has passed away, but the Colt Fire Arms Company remains, and has enlarged and extended its works. The Sharps' Rifle Company has, we believe, removed its principal works from Hartford, but has been succeeded by others; and among the later inventions and manufacturers of fire arms, and especially of rifles, carbines, and revolvers, are the Remington Arms Co., of Ilion, N. Y., the Winchester Rifle Co., of New Haven, Ct., which manufactures the Winchester rifle, and the Providence Tool Co., of Providence, R. I., which make the Peabody rifle.

The Sharps, Remington, Winchester, and Peabody rifles have been those principally used in the international target-shooting contests, in which our riflemen have so uniformly carried off the prizes. The use of metallic cartridges for our rifles, which began during our civil war, is now generally adopted, and has added very much to the precision of our rifle practice.

Among new inventions of breech-loading pistols is that of Stafford, of New Haven. The conical ball, as in the case of all breech-loading arms, is fixed ready for use in a copper cartridge, which is dropped from the left hand into the barrel when the pistol is held by the right hand. The barrel being attached to the stock by a hinge, is opened to receive the ball. Then, on throwing the barrel into line with the breech, by an upward jerk of the right hand, it is ready for use. There is a spring catch in front of the hammer of the lock which catches the barrel and holds it in position until the pistol is discharged. When the thumb is brought down on the catch, the barrel is disengaged, and, by a jerk, is thrown into position for reloading—the whole operation of loading and firing being accomplished in a small fraction of the time required to describe it. This must be so, for an expert can fire sixteen shots a minute with this pistol. The arrangement of sights is also complete, so that any object can be exactly covered by a marksman with precision, and the penetration and force with which the ball is projected can hardly be realized by those who have not experimented with it.

CANNON.—In 1860 the first of the many recent patents for breech-loading cannon was issued in the United States, France, and England. By this a ball cartridge is dropped into the gun by an opening in the breech, a pin moves forward, pushing the cartridge, closing the hole by which it entered, and discharging the piece by percussion powder. After careful and protracted trials, however, it has been very definitely settled, both in England and the United States, that no breech-loading cannon thus far constructed is either safe or effective.

The whole subject of ordnance, from its elements to its highest principles, has been carefully and profoundly studied since 1858. Many volumes have been written on the subject, and a great variety of methods of constructing guns have been tried, some with a greater measure of success than others, but it cannot be said that any of them as yet in all respects come up to the true ideal of a piece of ordnance. The exigencies which have grown out of the use of armored ships, have considerably complicated the matter. For naval service and for sea-coast or river forts, fortresses and batteries, it is requisite that the cannon should be very strong, of tenacious metal, free from liability to burst; of long range, and large calibre; if rifled, the missile thrown by it should have a high initial velocity, and great smashing or perforating power; the gun should be capable of efficient and tolerably accurate service at a distance of not less than five miles. Siege guns require very nearly the same qualities. For field service, in movable batteries and sections, smaller guns, usually those carrying balls weighing twelve, twenty, twenty-four, thirty, forty, or fifty-six pounds, are most in demand, and those of bronze, brass, steel, or wrought-iron, have generally proved serviceable, though the breech-loading principle has never been found very serviceable, even in the smaller cannon.

In the way of heavy guns, the English government have expended many millions in experimenting with Sir William Armstrong's guns — breech-loaders built up with successive layers of hoops and jackets, and which have proved a costly failure, being more dangerous to the gunners who served them, from their leakage and tendency to explode, than to the enemy. After many experiments Sir William changed his gun to a muzzle-loader, but its construction, though much improved by the modifications of Mr. Fraser, and rendered much less liable to explode, was not very satisfactory. An exception should be made perhaps in favor of the nine-inch calibre Fraser gun, which Gen. Barry, U.S.A., chief of artillery, pronounces, for its size and weight, the most efficient gun in the world. Whitworth's guns have come nearer to the true standard of excellence. They are constructed of homogeneous iron (a mild steel), and hooped with steel; can be used at will as muzzle or breech-loaders; the bore is hexagonal, and the rifling about one turn in ten or twelve inches. The missiles are a long flat-fronted steel-headed projectile (whether shot or shell), and from the rapid rifling revolve with almost inconceivable velocity. The gun is an expensive one to make, and can only be used with its proper projectile, but it possesses great merits. The Blakely gun was constructed on a different plan, its core being a steel tube, thickest in the middle and tapering towards each end, on which hoops of iron were driven. The bore was oval, but with four or five turns in the length of the gun. It was too apt to explode to be very safe. The Lancaster gun was the first to make use of the oval bore for rifling, but made fewer turns and did better service.

It can hardly be said, however, that in large ordnance England has produced the model gun. France has attempted the transformation of her bronze smooth-bores into rifled guns by what is known as the Palliser method—inserting a steel tube in the bore of a bronze or cast-iron gun, and screwing it in place by screws of great strength. This plan has been adopted with some of our cast-iron guns, and converts them into rifle guns of considerable power and endurance.

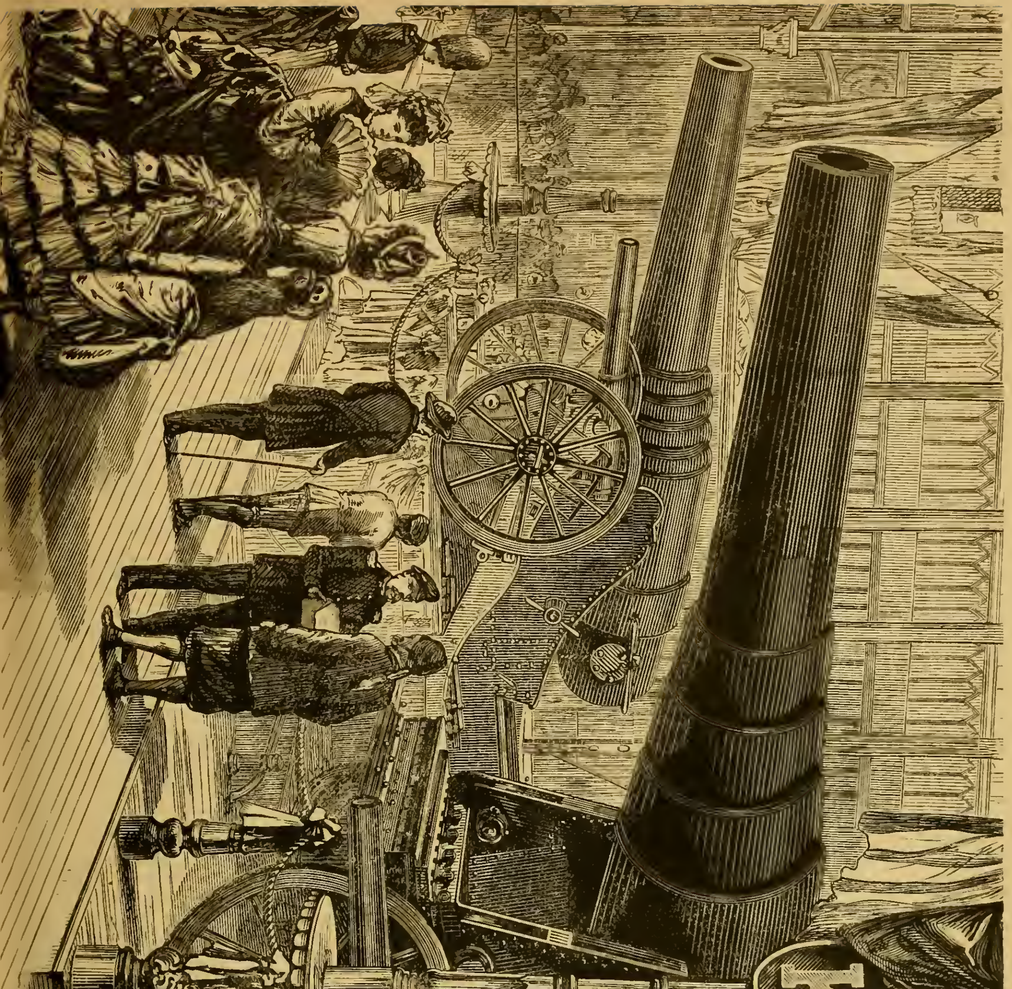
The method of Mr. Francis Krupp, of Essen, Prussia, is to fabricate the body of his gun from a solid ingot of low steel worked under heavy steam-hammers. The gun is strengthened by three or more steel tubes, which are shrunk upon the central tube or mass of the gun, the last ring or tube enclosing the breech being forged in one piece with the trunnions, and made without any weld. The rings are of different lengths, as is usual with built-up guns, and the whole gun is diminished in thickness toward the muzzle, not by tapering, but by being turned with concentric steps of diminished heights. Besides several thousand field guns, Herr Krupp has fabricated more than 2,000 of 6-inch, 7-inch, 8-inch, 9-inch, 11-inch, 12-inch, and 14-inch calibre, and more recently has made one of 20-inch, which sends out a projectile weighing over 2,000 pounds. All his guns are rifled. The first of his 14-inch guns required sixteen months of continuous labor night and day, and with its carriage and the turn-table (both of steel) on which it is mounted, cost $110,000. It had stood the test of 170 pounds of prismatic powder and a 1,200-pound projectile. At the beginning of the civil war (1861–65) we had no rifled cannon, and but very few of the European powers had any that were serviceable—Whitworth's and Krupp's being the only rifled artillery which had attained any reputation, and Armstrong's experiments being so far unsatisfactory. Some of our ordnance officers, both in the navy and army, and notably Captain (afterwards Admiral) Dahlgren, U. S. N., Capt. (afterwards Gen.) T. J. Rodman, U. S. A., and Capt. (afterwards Gen.) R. P. Parrott, had been experimenting for several years in regard to the best methods of constructing artillery for field, siege, and fortification use. Their material was cast-iron, though Capt. Parrott had been using reënforces of wrought-iron to strengthen the rifled guns he was constructing. No steel, bronze, or brass was used, except for the light guns of the field batteries. All the guns except Parrott's were smooth-bores, and, of their class, were perhaps equal in range and endurance to those manufactured in Europe. At the commencement of the war, there were in the various arsenals, forts, and batteries, 1,052 siege and sea-coast guns, of all sizes and calibres, and 231 pieces of field artillery equally varied in character. Of the heavy guns, the greater part were Columbiad's, invented by Colonel Bomford, U. S. A., in 1812–14, and which some years later were introduced into France by Gen. Paixhans, and called there Paixhans. Later still they were further improved by Col. Bomford. They were in their day guns of good repute, but their day had past. A few were Rodman's guns, perhaps the best smooth-bore gun then known. They were cast hollow with a core which was kept filled with cold water, the exterior being kept from rapid cooling by fires built around the gun in the casting pit. "These guns were further distinguished by great thickness of metal at the breech, by graceful curves of their exterior lines, by the absence of all exterior ornamentation, sharp angles or edges, and of the cascable and swell of the muzzle, and by having the trunnions at the center of gravity, thus doing away with preponderance, and greatly facilitating the service of the gun. At first, the Rodmans were all smooth-bores, but soon after the war commenced some of them were rifled. The calibres of the smooth-bores were 8 inches, 10 inches, 13 inches, 15 inches, and 20 inches, and of the rifles, 8 inches (corresponding exteriorly to the 10-inch smooth-bore), 10 inches (to 13-inch smooth-bore), and 12 inches (to 15-inch smooth-bore), three dimensions of carriage thus answering for six guns. All Rodman guns are adapted to the use of solid as well as hollow projectiles. The 15-inch Rodman gun weighs 25 tons, the solid shot 450 pounds, and the powder charge 100 pounds of mammoth powder. The 20-inch Rodman weighs 58 tons, its solid shot 1,060 pounds, and its powder charge 180 pounds of mammoth powder. These guns have done excellent service, and from their very heavy breech have burst less frequently than any other gun. For crushing or smashing power at short range, no gun could be more effective than the smooth-bore Rodman. The rifled guns have a much longer range, but are hardly so accurate as the Parrotts.

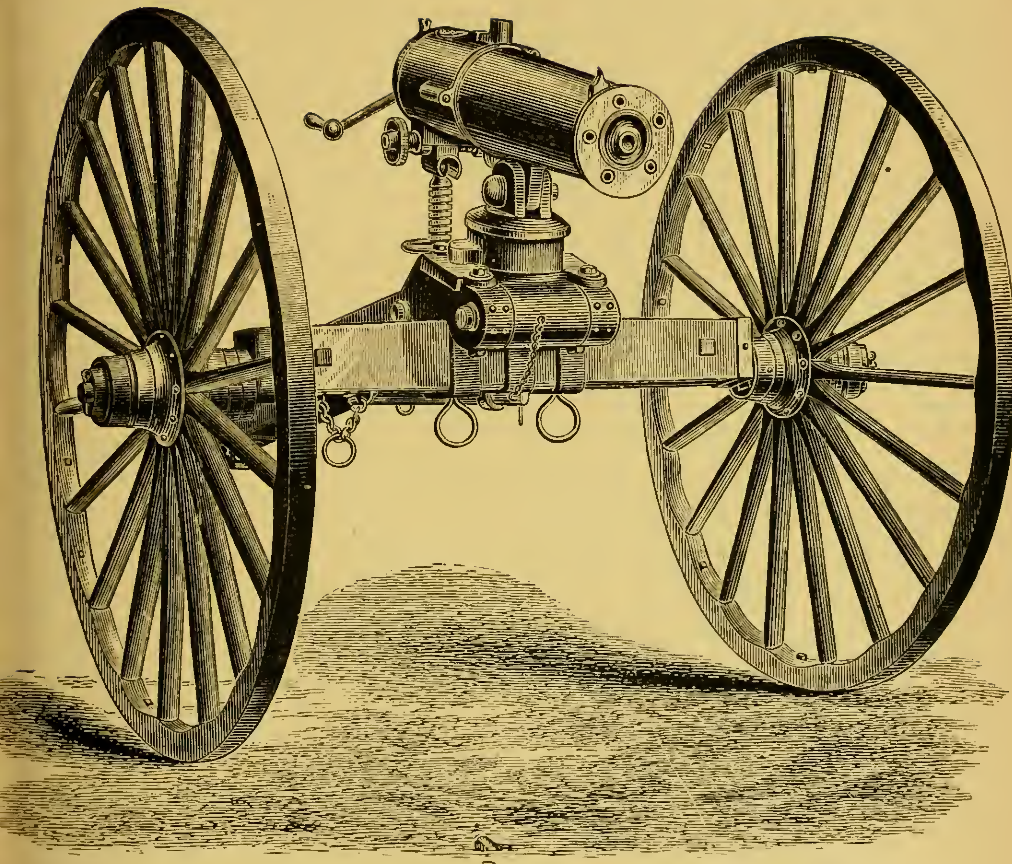
The smaller guns at the commencement of the war were partly Rodmans, but a larger number were howitzers—a modification of the Bomford columbiad—and a considerable number were imported brass or bronze guns. The Navy Department reported at that time 2,966 guns ashore and afloat of all qualities, sizes, and calibres. Of these, 2,008 ranged from 32-pounders down to pound swivels, and 958 were 8, 9, 10, and 11-inch guns of a variety of patterns; 356 being 9, 10, and 11-inch Dahlgrens. The burning of the navy yard at Portsmouth destroyed nearly half of these guns, and of the remainder not more than 420 were fit for service. Capt. (afterwards Admiral) Dahlgren, who had been for some years constructing guns for naval use, redoubled his diligence at this juncture, and produced as rapidly as possible guns of all grades for navy use. His howitzers were and still are a favorite gun for the smaller vessels, steam launches, etc., of the navy, but he is best known by his larger guns, constructed on much the same principles. "His guns," says Gen. Barry, "are of cast-iron, cast solid, and cooled from the exterior; they are of great thickness at the breech and as far forward as the trunnions, and from thence to the muzzle rapidly diminishing in thickness, so that their external configuration is not unlike that of a champagne bottle. The larger guns are chiefly of 9-inch and 11-inch calibre, and are adapted exclusively for hollow projectiles. A 10-inch Dahlgren for firing solid shot has, however, been put in service. The 15-inch and 20-inch naval guns, though they have in a great degree the exterior form of the Dahlgren, are cast hollow, cooled from the inside, and have the elliptical bottom of the bore, which are characteristic features of the Rodman plan. The 9-inch, 10-inch, and 11-inch Dahlgren guns have the bottom of the bore in the conical form of what is known as the 'Gomer chamber.'" The range of the 11-inch Dahlgren is considerably more than a mile.

The performance of a few of the Whitworth and Krupp rifled guns soon created a demand for rifled cannon in the Union army. There were several competitors, but the great cost of the experiments necessary to test the guns, and the total failures of some of them reduced the number materially. Gen. James, of Rhode Island, had invented, but not perfected, a rifled cannon just before the war, and his death caused by its explosion prevented further attempts to complete it. Messrs. Ames, of Chicopee, Mass., distinguished founders, and men of extraordinary mechanical skill and the highest character, expended large sums in endeavoring to perfect a wrought-iron gun, but it failed to meet the requirements of the government. Gen. Roberts constructed a rifled cannon of considerable merit, but it proved inadequate under some of the tests to which it was subjected. Capt. Parrott, at that time superintendent of the government foundry at Cold Spring, opposite West Point, was more successful than any of his competitors in meeting and overcoming all the obstacles to the production of an effective rifled cannon. In the Parrott method the body of the piece, or rather the gun itself, is of cast-iron, cast hollow, and cooled from the inside (after the plan of Rodman) for the larger calibres, and strengthened about the seat of the charge by an exterior tube of wrought-iron bars spirally coiled and shrunk on. For this purpose, this portion of the gun is turned down to a cylindrical form. Besides his field guns of three inches (10-pounder), and 3.62 inches (20 pounder), and his siege gun of 4.2 ins. (30-pounder), Captain Parrott constructed sea-coast and ship guns of 6.4 inches (100-pounder), 8 inches (200-pounder), and 10 inches (300-pounder). His mode of rifling is the increasing or gaining twist.

The smaller calibres, 10, 20, 30, and 60-pounders, were subjected to very hard service in the late war, and were wonderfully tenacious, very few of them bursting even when overloaded or discharged with great rapidity. The larger calibres, 100, 200, and 300-pounders, were most severely tested at the siege of Charleston, and some of these burst, though in most cases from the premature explosion of the shells with which they were charged. Their range was very great. In this siege they threw solid shot and shell with great accuracy at an elevation of 35° as follows: the 100-pounder, 8,453 yards—almost five miles; the 200-pounder, a solid shot weighing 150 pounds, 9,000 yards—five and one-sixth miles; and the 300-pounder, with a 250-pound projectile, five and one-fourth miles. The Parrott projectile, which has added greatly to the efficiency of these guns in both range and accuracy, is of peculiar form, elongated, and with its coating of lead or soft brass, which swedges readily in the grooves, is somewhat in the shape of a ten pin. The Parrott gun has some defects, but, as tested by actual service, it possesses the excellent qualities of considerable endurance, general serviceableness, great range, and remarkable accuracy in a degree equalled only by the Krupp guns, while its cost is hardly one-fourth of these, especially in the larger calibres.

When the iron gun, whether cast solid or hollow, has been dressed and drilled, it is ready to be proved, which is done in this country by testing the strength of a cylinder of the iron an inch in diameter and two inches long, cut out of the cannon, formerly from one of the trunnions, but now from the barrel near the muzzle. The specific gravity and other properties of the sample are carefully noted, and these, to-





NEW MODEL FIVE BARRELED GATLING GUN. WEIGHT, 97 POUNDS.

Exhibted by Gatling Gun Company, Hartford, Conn., as a practical military machine gun, the GATLING has no equal. It fires from 800 to 1,000 shots per minute with great accuracy. Various calibres are made, mostly having ten barrels, the larger having an effective range of over two miles. It has been adopted by nearly all the principal governments of the world. It received the only prize medal and award given for machine guns at the Centennial Exhibition.

gether with the trials to which it is subjected, and the hardness of the metal determined by a very exact method, give correct indications of the strength of the gun, without the necessity of submitting it to extreme proof by firing with constantly-increasing charges until the piece is destroyed. Indeed to such perfection have these proofs been brought, that guns have been selected as of inferior quality from among a large lot, which, on reference to the books of the foundry, were found to have been the only ones of the lot made of hot blast iron. According to the indications furnished by the tests, several guns are usually taken from each large lot of them to be submitted to extreme proof—the selection being generally of those that appear to be the poorest, best, and intermediate qualities. These are fired commonly with charges of powder equal to one-fourth the weight of the ball, with one shot and one junk wad over it. The firing is continued, unless the piece previously bursts, to 500 rounds. Then one ball more is added with every discharge, till the bore is filled. The powder is afterwards doubled in quantity, and the bore filled with shot at each discharge. When it bursts, pieces are selected for further examination from the breech, near the trunnions, and the chase. Guns are also tested by hydrostatic pressure, water being forced into the bore with increasing pressure, till it sometimes bursts the piece, or brings to light its hidden defects by opening the small fissures that were concealed in the metal. It is not uncommon for it to appear upon the exterior of pieces, of which the thickness of the metal is four inches, exuding through as a thin froth, which collects upon the outside, and forms drops and little streams. By this method the exact pressure applied is known, and may be gradually increased to any desired degree. Sample bars are also cast together with the cannon, which furnish some indication of the strength of the metal. The different rates of cooling of the large and small mass, however, render their qualities somewhat dissimilar.

Extended experiments have shown that gunpowder can be greatly improved by increased care in the selection and manipulation of its ingredients, and by greater uniformity in the form and size of its grains; and it has been further demonstrated, that it is essential to vary the size of the grain for different calibres of cannon; that is to say, a large grained or slower-burning gunpowder is more advantageous for the larger cannon since it gives increased initial velocity with decreased pressure on the walls of the gun. Gunpowder in the U. S. service is now classified into five kinds: 1, *Rifle* powder, for pistols and carbines; 2, *Musket*, for rifled muskets; 3, *Mortar*, for field and siege guns and mortars; 4, *Cannon*, for the smaller calibres of sea coast guns; 5, *Mammoth*, for 15-inch and larger guns. These improvements in the manufacture of mammoth powder have been so marked, that with charges of similar weights the initial velocity of a 15-inch projectile has been increased from 1,300 or 1,400 feet per second, with a pressure of 40,000 to 60,000 pounds to the square inch, to 1,800 feet per second, with a pressure of less than 30,000 pounds per square inch. This has greatly increased the range and diminished the danger of the cannon's bursting.

The exigencies of the late war, as well as those of the frontier warfare with the Indians, demanded what may properly be called a battery of rifles. This want had been felt before both in Europe and this country, and attempts had been made to supply it, with no great success till 1862, when Dr. R. J. Gatling, now of Hartford, Conn., invented the machine gun since known as the Gatling gun. Both the French and Germans used in the Franco-Prussian war of 1870 machine guns of a somewhat analogous construction, known as the *Mitrailleuse* and the *Kugelspitzen* respectively; but the Gatling is the most simple and effective weapon of its class. It consists of a number (usually ten) of simple breech-loading rifled barrels grouped around and revolving about a common axis with which they lie parallel. These component barrels are loaded and fired while revolving, the empty cartridge shells being ejected in continuous succession. Each barrel is fired only once in a revolution, so that the Gatling gun fires ten times in one revolution of the barrels. An active man can turn the crank with sufficient rapidity to make forty revolutions a minute for several minutes together, and thus deliver 400 rifle shots a minute. The working of the gun is simple. One man places one end of a feed-case containing forty metallic cartridges, of the kind used in the Springfield rifle and other small arms, in a hopper at the top of the gun, renewing the supply as fast as used, while another man turns a crank by which the gun is revolved. If the feeding is kept up steadily, and the crank is steadily turned, the gun will discharge a constant stream of fire, which, by the aid of a contrivance called the oscillator, will make terrible havoc with an approaching column, whether of infantry or cavalry. The mechanism by which the successive charges are made to fall into place and are discharged with such rapidity, and with the utmost safety from accident, is very ingenious, yet simple. It cannot well be explained without several drawings, but it reflects the highest credit on the inventor.

Gen. Q. A. Gilmore says: The advantages possessed by this gun are the lightness of its parts; the simplicity and strength of its mechanism; the rapidity and continuity of its fire without sensible recoil; its effectiveness against troops; its general accuracy at all ranges attainable by rifles; its comparative independence of the excitements of battle; the interchangeableness of its ammunition with that of the same calibre of small arms, and its great endurance. Of course, it cannot supply the lack of cannon in a siege, or of the large cannon in length of range; nor can it deliver a curved fire, or prove effective against troops in rifle-pits, or behind blockhouses or heavy woods; but it is peculiarly adapted to the defense of entrenched positions and villages; for protecting roads, defiles, and bridges; for covering the embarkation and debarkation of troops, or the crossing of streams; for silencing batteries by driving off the gunners; for increasing the infantry fire at the critical moment of a battle; for supporting field batteries against assaults and charges; for covering a retreating column; and for its economy in men for serving and animals for transporting it. The guns are made of seven calibres, ranging from 1 inch to 0.42 inch; the heaviest weigh but 650 pounds, the three smaller calibres only 200 pounds each. These latter with gun carriage and limber complete weigh but 713 pounds, and can be brought rapidly on the field by one or two good horses.

Another machine gun, "the improved Gardner Machine Gun," has been put upon the market since 1874. It is entirely different from the Gatling, has but two barrels, but works easily and with great rapidity, 493 to 500 cartridges being discharged, though by great effort, in a minute. It is more accurate at considerable distances than the Gatling, but is adapted to a somewhat different service. The Gardner weighs with its tripod only 201 pounds, and without it 147 pounds. It has been favorably reported upon by the Ordnance officers.

It has been settled beyond controversy, that the destructive power, the "smashing power," as the artillerists say, of a cannon shot is largely dependent upon the quantity of powder which can be thoroughly ignited in the chamber of the gun before the projectile leaves its muzzle. A gun which, sending a 450 or 500-pound projectile, can burn one hundred pounds of powder before the ball leaves the cannon's mouth, without exploding the gun with the powder, will send that projectile (other things being equal) with a force which no armor plate at three hundred yards' distance can resist. A six-inch plate, backed with ten feet of solid timber, would be crushed and crumbled into fragments, and if the projectile was of hardened steel it would very probably pass through the opposite side of the ship. The intimate relation of heavy guns to the armor of the ships, and the attempt to make an impenetrable armor on the one side, and an irresistible projectile on the other, have occupied a great deal of attention for twenty years or more. The French commenced experiments in 1854 and have continued them ever since. The English began still earlier. The war of 1861 at once demonstrated the necessity of armored ships, and our government made haste to build them. The first Monitor, and the Galena, a wooden armored vessel, were earliest afloat, and the former, not a moment too soon, attacked and disabled the Rebel iron-clad Merrimac. Subsequently other monitors, and the New Ironsides, an armor-plated ship of the line, were sent out. The monitors did good service in besieging forts and seaports, but were not adapted to ocean-fighting, or rough water navigation. On the western rivers a class of iron-clads adapted to river navigation, as well as those of lighter plating, commonly known as tin-clads, were rapidly constructed. Other armored vessels, mostly modifications of the monitor principle, though possessing better sea-going qualities, were built, though not generally until too late for service in the war. The Puritan and Dictator, gigantic monitors, were neither of them put in commission. The Miantonomoh and her consort, turreted iron-clads, but of a different model, have proved the best of our armored ships. The Dunderberg, an iron-plated ram of great size and immense power, was sold by its builder, with the consent of the U. S. government, to the French, and now forms one of the most formidable vessels of the French navy. It is worthy of note that our most famous naval victories, whether over single ships or in squadrons, were fought by wooden vessels mainly. The Kearsarge, which fought and sunk the Alabama, was a wooden ship; the fleet of Admiral Farragut, which ascended the Mississippi to New Orleans, as well as that which subsequently passed Port Hudson, were wooden ships. The fleet which captured the forts at the mouth of Mobile Bay, and crippled the Rebel iron-clads were mostly wooden vessels, and of the five iron-clads in the Union fleet, one was sunk by a torpedo. In the siege of Charleston, the iron-clads did some service, though but little compared with the shore batteries, and at the taking of Port Royal, it was wooden ships alone which bombarded and silenced the forts.

Our harbor-defences employ the largest portion of our heavy guns; yet very few of our harbors are in a complete state of defense. New York, the most important and the most exposed of these, has numerous forts at both entrances to its harbor, Long Island Sound and the Lower Bay, mounting 15 and 20-inch Rodman guns, both smooth-bore and rifled, and 10 and 15-inch Parrotts. The plan of a revolving iron tower to be placed in the center of the channel, on an artificial island, for harbor defense, was first broached by Mr. Theodore R. Timby, of New York, in 1841, and his plans, thoroughly perfected, were presented to the government and the people in 1863 or 1864, but have not as yet been adopted. It was from Mr. Timby's model of a revolving iron tower, that Capt. John Ericsson gained his idea of a turret for his monitors.

# CUTLERY, EDGE TOOLS, FILES, AND SAWS.

It is not half a century since all our pocket-cutlery, scissors, razors, table-knives and forks (when made of steel), carving-knives and forks, and files and surgical instruments were imported from Europe, and most of them from Sheffield, England. We made even at that time our own axes, and most of our saws, planes, adzes, and other of the larger cutting instruments, and had even then begun to send abroad a few of our axes, scythes, hoes, and sickles, but we were told, and believed it implicitly for many years, that our workmen had not the skill nor the long practice which would enable them to make pen-knives, scissors, razors, table-cutlery, files, or surgical instruments. These, we were told, required a very long apprenticeship, and a peculiar sleight of hand which we, as outside barbarians, could not acquire. But somewhere about 1835 a file factory was set up in New Haven, Conn. It was a very small affair at first, and the file-maker wrought alone for a while, but after a time taught the mystery of his art to some bright boys who in turn taught others, and ten years later it began to be whispered about that the New Haven files were better than the English. In 1870, there were 121 file factories in the country (there are about 200 now), files were made to the amount of $1,649,434, and files had ceased to be imported. About the same time the manufacture of table-cutlery was commenced. The Sheffield cutlers were sure that this would prove a failure. No American blacksmith could make knives and forks equal to Wade and Butcher's. Perhaps not, but they could make better ones; and it was not long before they had invented swedging machines of tremendous power, by which they struck out the knife, blade, and handle, or blade and tang, in one piece, instead of welding, and hammering, and smithing it out by a half dozen pieces. This was so much of an improvement that even the Sheffield cutlers had to use it, but they still insisted that we could not finish our table-cutlery as well as they could. At their own International Exhibition, in 1851, and at every one since, our manufacturers of table-cutlery have taken the first prizes. And the silver and silver-plated forks of American manufacture have taken the first place in the markets of the world. So long ago as 1838 or 1840, two or three surgical instrument manufacturers began very modestly to compete with the surgical instrument makers of Paris, London, Berlin, and Vienna. They were told that they would only bring ruin on themselves, that these implements required a perfection of finish which they could never attain; and most of the physicians and surgeons at first were inclined to prefer the imported instruments, but after a while it was found that the American instruments were really superior to the imported, and now there are very few surgical instruments brought from Europe, while our export of them is increasing. Scissors were the next article in which our manufacturers encroached upon the English cutlers, and here the outcry broke into a wail. Rodgers and Wostenholm, cutlers of Sheffield, had supplied the American women with scissors and the American tailors with shears from time immemorial, and it was nothing less than sacrilege to think of taking this business away from them. "The next thing," it was said, "would be that the conceited Americans would think they could make their own pocket-knives." "And so we will," was the answer. But the scissors were first in order. An American machinist or metal-worker always looks first at the form of an article which he wishes to make to see if he cannot improve that. It was so in this case. The Sheffield men had gone on for generations making their scissors in just the same way, two blades of steel crossing each other on the same plane, and with the same leverage The quick eye of the American mechanic saw that the leverage might be greatly increased, the cutting made easier, and the whole blade utilized by a change in the shape of the blades and handles, and that each blade could be struck out in a single piece by a swedging die. Having made this improvement, which turned out to be a very important one, he next proceeded to finish the scissors and shears in the best manner, and very soon he not only supplied the American market, but began to export his shears, even to Sheffield itself. The cutlers stood aghast. They had been beaten at the very point where they supposed they were strongest. One of them, holding up a pair of American shears before his workmen, said, "I will give £25 ($125) reward to any man who will contrive a plan by which we can make shears equal to these." There was no response, though he repeated the offer.

There had been much of the cheaper and some of the better pocket-cutlery made in this country prior to 1860, but it had not attained a very good reputation; even Congress, which should have been ready to sustain American manufactures, insisted upon being supplied with Rogers' and Worstenholms's penknives and erasers. The plan adopted was for bids to be received for supplying Congress with stationery, and the successful bidder sent on the articles, including the cutlery, and later, when the appropriation was passed, drew his money for the goods. It was customary for the English houses to give a credit of six months to the stationers. When the war was in progress, in Oct., 1861, it happened that partners in these great cutlery houses of Sheffield were in New York. The stationer who was to supply Congress applied to one of them to sell him his cutlery on the usual terms. "No! not a penny-worth," was the answer, "without the cash in advance." "But I want it for Congress," said the stationer. "I wouldn't trust the Government of the United States for a sixpence," answered John Bull. The other cutler was not quite so stern, but he insisted that the order must be indorsed by an English house. Our machinists and metal-workers had just then rather too much business on hand in supplying the demands of the war to give immediate attention to pocket-cutlery; but it was not long before they produced goods fully equal and in most respects superior to the English, and Congress has since been supplied with American knives and erasers.

As in all the other branches of the cutlery and edge-tool manufactures, machinery of precision is much more largely used than in Europe, and it gives a much greater uniformity and excellence to the products than is attainable by the uncertainties of even the most skillful hand labor. There are, however, considerable quantities of fine pocket-cutlery yet imported, although it has lost much of its prestige. Razors were the last of the articles of fine cutlery to be produced here. Wade and Butcher's razors were so long regarded as the standard that people in general had the idea that it was in a sense discreditable to be shaved with any other, and the first attempts at making razors here were treated with derision. "The Americans might," it was said, "succeed in making table-knives and scissors by machinery, but a razor was a different affair altogether; the steel and iron must be so carefully welded, and their fibers so intimately blended that the razor could be ground down to the finest edge on one side, and retain its thickness on the other, and this was not to be done by machinery; it required workmen of peculiar skill and tact, and it required, also, peculiar skill to give the razor its exact temper, and to make that temper enduring. The American mechanic might, to be sure, make what he would call razors, but they would be—like Peter Pindar's razors—made to sell." And so they were, and to use, too, and it has come to pass that very many experts prefer the American razors for their easy handling, their perfect concavity, and their excellent and permanent temper. They differ slightly and advantageously in form from the English, and like the scissors and table-knives they are struck out by a die, and then ground and tempered with the most careful accuracy. It is now known that our cutlery steel is superior to any other in the world; and that, with a little more experience in tempering and finishing it, our razors and penknives will not be equaled anywhere. There is one error into which American mechanics and manufacturers are liable to fall, which must be carefully avoided if they would maintain the reputation they have fairly won. In many departments of the useful arts they produce excellent goods, and goods which speedily acquire a good name and are in extensive demand; but when, as the saying is, they have attained success and their names are up, they grow careless, and send off inferior goods in place of those of the first quality. Nothing can be more fatal to any permanent success than such a course. The effort should be to improve the manufacture in all its details constantly, rather than to suffer the slightest deterioration in its quality. Eternal vigilance is said to be the price of liberty; it certainly is the price of manufacturing success.

In the manufacture of saws, there have been several improvements made within the past ten or fifteen years which have greatly expedited the work, as, for instance, those modifying materially the form of the teeth; those enabling one man without great or exhausting effort to perform the parts of the top and bottom sawyer; and those which render the setting of a saw a much easier and less disagreeable business. American saws now have a world-wide reputation.

In the manufacture of axes, as well as of all other edge tools, we have long maintained a preëminence the world over. Collins' axes and scythes are as well known abroad as at home, and there is something in the shape, proportions, and balance of an American axe which the European mechanic has tried in vain to imitate. Three or four years ago, a Collins axe was presented to Mr. Gladstone, who is an expert in felling trees. He tried it carefully on his own estate at Hawarden, and declared that it was by far the best axe he had ever used. Scythes, cradles, sickles, and grass knives, and all the tools of the carpenter, ship-joiner, and cooper, are made in these American factories with a perfection which has never been seen elsewhere. Almost all of these, perhaps all, are stamped out by dies of the hardest steel, and are so perfect and uniform in their workmanship that the several parts of a hundred of them might be interchanged without any difficulty. We have not thought it desirable to go into details in regard to the processes of manufacture of these articles, because the inventive genius of our mechanics is constantly devising new methods which take the place of the old ones, and simplify while they perfect the processes of manufacture. An exception may be made in the process of tempering, or at least in the degrees of heat necessary to produce a given temper, since this is a constant quantity. The process of hardening renders all steel brittle, and it is intended to remove this by tempering. The higher the heat when the metal is hardened, the softer and stronger will be the steel. A lower degree of heat gives more hardness, and also more brittleness. The temper is indicated in the color, and the temperature which produces that color follows a regular scale. Thus, 430° of heat gives a very pale straw color, suitable for the temper of lancets. Higher degrees of heat give darker shades of yellow, suitable for razors, penknives, and chisels; until at 500° the color is brown-yellow, adapted to axes and plane-irons; 20° higher, the yellow has a purple tinge, seen in table knives; 30° more and the dark color of a watch-spring is obtained. Again 20° and the dark blue of saws is visible. At 630° the color has a tinge of green, and the steel is too soft for instruments. These colors are supposed to be produced by the action of the oxygen of the air upon the carbon of the steel, and to protect the metal in some degree from rust. As we have said, the importation of cutlery, files, saws, and edge tools continues, though it has become much more limited during the past decade than heretofore. In 1860, the importation of cutlery alone was $2,240,905. In 1870, it was $1,695,238, and the files, saws, and tools made $766,442 more.

The value of the importations of these articles at various dates in the last decade were as follows:—

| Articles. | 1871. | 1873. | 1875. | 1877. | 1879. |
|---|---|---|---|---|---|
| Cutlery, . . . | $1,956,351 | $2,234,335 | $1,440,429 | $875,276 | $1,171,924 |
| Files, . . . . | 604,153 | 770,986 | 359,437 | 135,585 | 91,719 |
| Saws and Tools, | 514,346 | 265,637 | 24,712 | 13,507 | 6,281 |
| Totals, . . | $3,074,850 | $3,270,978 | $1,824,578 | $1,024,368 | $1,279,924 |

But if the importations decreased, the exports increased in a corresponding ratio, as will be seen by the following table. We have no record at hand of the amount of our exports of these articles in 1860, but they must have been very small, probably less than $100,000, and this mostly in Collins' axes and a few scythes. In 1869, the total was $417,786; in 1870, it had increased to $486,617, and thenceforward the increase has been constant, till in 1879 and 1880 it had nearly balanced the imports, and embraced not only most of the edge tools in large quantities, but considerable values in fine cutlery.

| ARTICLES. | 1871. | 1873. | 1875. | 1877. | 1879. | 1880. |
|---|---|---|---|---|---|---|
| Cutlery, . . | $114,142 | $47,346 | $38,080 | $38,714 | $65,277 | $71,122 |
| Edge Tools, . | 424,821 | 846,452 | 676,933 | 721,012 | 860,528 | 926,882 |
| Files and Saws, | 9,282 | 10,171 | 32,134 | 36,309 | 34,351 | 31,118 |
| TOTALS, . | $548,245 | $903,969 | 747,147 | $796,035 | $960,156 | $1,039,122 |

We regret that we cannot give the census statistics of these articles for 1880, but as yet not even a preliminary report of them has been published. The great increase of the exports since 1870 shows conclusively that the production has largely advanced since that date, for there has certainly been a corresponding increase in the home demand. The following are the statistics reported in 1870:—

| ARTICLES. | No. of Establishments. | Hands Employed. | | | | Capital Invested. | Wages paid. | Raw Material used. | Annual Production. |
|---|---|---|---|---|---|---|---|---|---|
| | | All. | Males. | Females. | Youth. | | | | |
| Cutlery, ................ | 82 | 2,111 | 1,896 | 150 | 65 | $2,246,830 | $973,854 | $762,029 | $2,882,038 |
| Edge Tools, ........... | 102 | 2,317 | 2,070 | 76 | 171 | 1,880,717 | 1,157,904 | 862,014 | 2,739,998 |
| Files, ................... | 121 | 1,581 | 1,356 | 59 | 166 | 1,659,370 | 638,982 | 468,303 | 1,649,394 |
| Saws, ................... | 72 | 1,595 | 1,457 | 8 | 130 | 2,883,391 | 995,609 | 1,332,891 | 3,175,289 |
| TOTALS, ............ | 377 | 7,604 | 6,779 | 293 | 532 | $8,670,308 | $3,766,349 | $3,425,237 | $10,447,484 |

There is reason to believe that the manufacture of surgical instruments, which had an annual product of about $550,000 in 1870, and has since been largely extended, was not included under cutlery, but arranged under another group with "Instruments, professional and scientific." If so, the annual product under this head, in 1870, should have been about $11,000,000, and that of 1880 probably not far from $20,000,000. In 1870, Massachusetts took the lead in cutlery, and Pennsylvania followed, the two states producing more than three-fourths of the whole. In edge tools, Connecticut led and New York followed, the two producing four-fifths of the whole. In files, New York, Pennsylvania, Rhode Island, and Massachusetts produced nearly four-fifths of all. In saws, Pennsylvania, New York, Missouri, and Ohio produced seven-eighths of the whole.

# FURS AND FUR TRADE.

Among the natural products of the new world, the valuable furs of the various wild animals which peopled its boundless forests, its rivers, lakes, and seas, were soon appreciated by the early discoverers and explorers. For many centuries the choicer varieties of fur had been held in the highest estimation, and the use of such as the ermine and sable was monopolized, by special enactments, by the royal families and nobility of both European and Asiatic countries. A market was therefore ready for the large supplies which were soon furnished to the early settlers by the Indians in exchange for the trinkets, liquors, and numerous articles of trifling value brought from Europe for this trade. The English and French competed with each other to secure the control of the business around Hudson's Bay and in the territories now constituting British America, extending from the Atlantic to the Pacific. Each nation established its own trading posts, or "factories," and protected them by forts, and the possession of these often passed by conquest to the rival party. The incorporation of the Hudson's Bay Company in 1670, by Charles II., gave a decided stimulus to the English interest, by securing to men of great influence and wealth, the control and monopoly of the fur trade throughout the possessions claimed by the British. The enormous profits realized by this company induced the Canadians, in the latter part of the last century, to form another company, which they called the North-west Fur Company, and whose field of operations was nominally limited to the territories ceded to the English by the French in 1763. Early in the present century their factories were extended westward to the rivers that flow into the Pacific, and they employed of Canadian voyageurs and clerks, who were mostly young men from Scotland, about 2,000 persons. They acquired possession of Astoria, at the mouth of the Columbia, in 1813, and vigorously competed with the old company—the two associations carrying on open war throughout the wild territories known only to these fur traders and the Indians they controlled. By act of parliament, the two companies were united in one in 1821, and their operations have been continued under the name of the Hudson's Bay Company until 1859, when their last special license of 1838 expired. The company has exercised a despotic sway throughout the territories it occupied, compelling the labor of the poor French voyageurs and the Indians, and causing them to subsist upon the most meagre fare and pitiful allowance. Sad tales of their sufferings are familiar to those who have visited these northern regions. The company established an express by the way of the great lakes and the western rivers, and by numerous relays, always ready, information was conveyed by canoes and by land travel in an incredibly short time from the head-quarters of the company at Montreal to the most distant posts on the Pacific. Their furs collected on both sides of the continent were transported to London for the great annual sales of March and September. From London many were sent to Leipsic, for the great annual fair at this famous mart.

While these extensive operations were in progress, the inhabitants of the provinces now constituting the United States derived little or no benefit from the trade so long as they remained British colonies. In 1762, an association was established among the merchants of New Orleans, for conducting the fur trade in the regions on the waters of the Missouri and its branches; and this led to the founding of St. Louis in 1763, by Laclede, the leader of the organization. This place was made their head-quarters for the reception of furs collected by their voyageurs in distant excursions by canoes and Mackinaw boats toward the Rocky Mountains, among tribes of Indians who often attacked their parties, but who, controlled by the talent and wise policy peculiar to the French, became at last firm friends of the enterprise, and bound to the interests of the Chouteaus and others by whom it was conducted. From St. Louis the peltry was boated down the river to New Orleans, or up the Illinois to Lake Michigan, and thence to the great trading post of Mackinaw. From this it was forwarded by the lakes and the St. Lawrence to Quebec, to be shipped to England. Over the same routes were returned the groceries, etc., for the supply of the traders, which, so slow were the means of transportation, were the returns in part of the furs collected the fourth preceding year. But though the expenses of the long voyages more than doubled the cost of the supplies after they left Mackinaw, the profits of the business were not rated at less than 300 per cent. For fifteen years preceding 1805, the annual value of the peltry collected at St. Louis is stated to have been $203,750; and the value of the goods annually sent up the Missouri during about the same period was estimated at $61,000. Deer skins constituted the greater portion of the product, and they were, indeed, the chief medium of exchange, the value of articles being rated at so many shaved deer skins. Beaver and otter were the next in importance, and buffalo skins, which are now the chief object of the trade, were then scarcely collected at all.

From the year 1818, the fur trade of the north has been conducted almost wholly by organizations which have sprung from these early operations. It was extended by the associations established at St. Louis to the regions beyond the Rocky Mountains, and there carried on at immense sacrifice of human life, from the dangers naturally incident to the pursuit, and the unappeasable hostility of the savage tribes. In 1847 it was estimated that the annual value of the trade had averaged for forty years from $200,000 to $300,000, and the latter portion of this period much more than the larger sum named. But, like the discovery of gold in California, its greatest importance was the opening of uncultivated territories to the advance of civilization, and the introduction of a permanent population for the establishment of new states.

During the last century the fur trade had attained to no importance in the eastern states. Mr. John Jacob Astor, of New York, engaged in it in 1784, buying in Montreal and shipping to England. But under the treaty of 1794 he was enabled to introduce fur from the British provinces into New York, and he then opened a new trade direct with foreign countries, shipping peltries even to China, and receiving in exchange the rich products of the East Indies. As his operations prospered, he engaged in the early part of the present century in the collection of furs along the northern frontier, a field which had before been in exclusive possession of the North-west and Hudson's Bay Companies; and he labored zealously in the great national enterprise of diverting this important trade from the exclusive control of foreign companies, and causing it to contribute to the commercial interests of the United States. With wonderful energy, and dependent almost solely on his own resources, he carried on these gigantic operations, having in 1808 a capital of no less than $1,000,000 invested in them. In 1810 he established the Pacific Fur Company, for the purpose of forming a settlement on the Pacific coast, and by means of it carrying out the grandest commercial scheme that had ever been undertaken. His ships, leaving New York with supplies for the colony, were to obtain from it and by trading along the coast cargoes of furs to be sold in China, and there loading with teas, silks, etc., would return to New York, making a complete circumnavigation of the globe. Mr. Astor was bound by his articles of agreement to furnish capital to the amount of $400,000 if required, sending each year an expedition around by sea and another across the country to the mouth of the Columbia, and the profits were to be equally divided between his associates and himself. Notwithstanding a succession of disasters, Mr. Astor continued for three years to despatch a ship bound around Cape Horn, to the mouth of the Columbia, having unshaken confidence in the final success of the enterprise. And such, no doubt, would have been the result, had not his principal Canadian partner, who controlled the affairs at Astoria (the settlement on the Pacific), proved treacherous and given up the post to the rival North-west Fur Company for a mere nominal price, on the pretence that it would certainly be seized by the British cruisers during the war. This occurred on the 16th October, 1813.

From that time the operations of Mr. Astor were restricted to the northern territories lying east of the Rocky Mountains. His factories were at Mackinaw, and at the foot and head of Lake Superior, upon whose waters he maintained sailing vessels long before they were visited by the explorers of copper mines. Up to the year 1845 the only business prosecuted upon its distant shores was that of the fur hunter, and they were, in fact, known only to this class and to the wandering Chippewa and Sioux tribes of Indians. The territory of Minnesota, also, and the still more western regions, were frequented only for the same object previous to 1848. From that period, or even earlier, the fur trade has declined in importance, and its profits have been divided among larger numbers of adventurers. The house of Pierre Chouteau, jr., & Co. had been distinguished for many years as the most enterprising of those engaged in the trade; and in 1859 one of their steamboats ascended the Missouri river to the Great Falls, near the Rocky Mountains, about 3,950 miles from the Gulf of Mexico, and returned laden with buffalo robes. Thus the trade still continues to be the pioneer of civilization—opening new roads into wild territories for the advance of permanent settlers.

St. Paul, Minnesota, has been for thirty-five years past the chief trading post for fine furs in the United States, though Sitka, in Alaska, is an important point for the seal and other furs of the Northwest coast. Over 100,000 fur seal-skins are shipped from Alaska annually. The great Fur Companies have now virtually ceased to exist, or are fast winding up their affairs, and the fur trade is almost entirely conducted by individual purchasers directly with the trappers. In 1870, the Alaska Commercial Company was organized and leased the islands of St. Paul and St. George, in the Aleutian group, for the purpose of prosecuting the fur seal fishery. They pay an annual rental of $55,000 for the islands, and a royalty of $2.62½ for each fur seal taken, and are not allowed to take over 100,000 in a year. These skins bring from $25 to $40 each, and find a ready market in London and New York. They also take from 2,000 to 5,000 sea-otters every year, whose skins are worth from $75 to $100 each. Aside from what are known as fancy furs, *i. e.*, those worn as articles of dress, the principal traffic in furs has been in buffalo robes. The gray wolf, the grizzly bear, the lynx, and the red, cross, and gray fox also furnish skins for robes of the fancy sort. There is also a very considerable business done in hatters' furs, for which purpose the fur of the rabbit or hare, the squirrel, the muskrat, and the wild and domestic cat are mostly required. Beaver fur is now seldom used for felting. The fur of the raccoon is largely exported to Germany, where it is used for linings of overcoats, etc.

From these facts it is apparent that the character of the important furs has greatly changed since the early periods of the trade. While the beaver and the otter, and even the marten and fisher, two animals of the sable kind, fell off largely in relative importance, the skins of some of the smaller animals, as the mink, assumed a much higher value, and even the skins of the common muskrat commanded a high price. The highest-priced furs were the Russian sable, the sea-otter, and the black or silver fox. These are still valuable, though they command much lower prices (except the two last named) than formerly. In the latter part of the last century the skin of the sea-otter was in such demand that several expeditions were fitted out from this country, and also from Europe, expressly for collecting this fur from the islands and coast about Nootka Sound. The silver fox is found in the northern part of this continent, and is occasionally captured in the region about Lake Superior. The value of the skin is even greater than that given in the above table—being often rated at $60 apiece; in Europe, when well dressed, they have been known to bring nearly as many guineas. They are in demand for the most costly outside garments and trimmings. Of late years the fashion has changed, and the skin of the fur seal, mainly from Alaska, has been the most costly of fur garments, though the black and silver fox skins are much used for trimming silk cloaks. The skins of the skunk for the last fifteen years have been largely collected, and many thousands have been annually exported from New York. Those of black color were worth the most, and sometimes brought 75 cents each. The demand for these, which at one time fell off, has been revived, the Parisians having again brought them into demand as black marten furs, and the objectionable odor being entirely removed by a new process. They are now the most popular of the furs of moderate price, having largely replaced the mink furs. The fashion will doubtless soon change again and some other fur be in the ascendant. The skin of the Siberian squirrel is much used for lining cloaks, etc., but, except for children's use, it is not worn externally. Coney fur, as described in the account of the hat manufacture, is an article of considerable trade. It is obtained chiefly from Europe, and is mostly consumed by the hatters, for whose use nothing but the fur itself in fleeces is imported. The whole skins are used to some extent by the furriers for cutting.

The present character of the trade, and value of skins, are seen in the following statement from the circular of one of the oldest and most extensive houses in this business—that of Messrs. C. G. Gunther's Sons, 502 and 504 Broadway, New York. To their experience we are indebted for many of the particulars that follow:

| | | | | | |
|---|---|---|---|---|---|
| Bear, Northern, according to size and quality, | Prime, | From | $10.00 | to | $15.00 |
| " Southern and Northern yearlings, | " | " | 2.00 | to | 5.05 |
| Beaver, Northern, per skin, Parchment, | " | " | 2.25 | to | 3.75 |
| " Southern and ordinary, per skin, | " | " | 1.00 | to | 1.50 |
| Badger, or Wolverine, | " | " | 3.00 | to | 5.00 |
| Cat, Wild, Northern and Eastern States, cased, | " | " | 0.25 | to | 0.40 |
| " " Southern and Western, | " | " | 0.20 | to | 0.25 |
| " House, ordinary, if large, | " | " | 0.08 | to | 0.12 |
| " " Black, furred, | " | " | 0.25 | to | 0.40 |
| Fisher, Northern and Eastern, according to size and color, | " | " | 9.00 | to | 12.00 |
| " Pennsylvania, Ohio, and Western, do | " | " | 9.00 | to | 12.00 |
| " Southern, do | " | " | 1.00 | to | 3.00 |
| Fox, Silver, do | " | " | 25.00 | to | 50.00 |
| " Cross, Northern and Eastern, do | " | " | 2.00 | to | 5.00 |
| " Red, Northern and Eastern, do | " | " | 1 75 | to | 2.00 |
| " " S. Penn., N. Jersey, and N. Ohio, do | " | " | 1.25 | to | 1.50 |
| " " Southern and Western, do | " | " | 1.00 | to | 1.25 |
| " Gray, Northern and Eastern, cased, do | " | " | 0.80 | to | 1.00 |
| " White, do | " | " | 2.50 | to | 4 00 |
| " Kitt, do | " | " | 0.50 | to | 0 60 |
| " Blue, do | " | " | 2.75 | to | 3.25 |
| Lynx, do | " | " | 8.00 | to | 15.00 |
| Marten, States, do | " | " | 2.00 | to | 5.00 |
| Mink, N. York, N. England, Minnesota, and California, according to size and color, | " | " | 0.70 | to | 1.75 |
| " Southern New York, New Jersey, Pennsylvania, Ohio, Michigan, Indiana, Wisconsin, and Iowa, according to size and color, | " | " | 0.80 | to | 0.90 |
| " Maryland, Va , Ky., Mo., and all Southern, according to size and color, | " | " | 0.30 | to | 0.40 |
| Muskrat, Northern New York and Eastern, | Spring, | " | 0.10 | to | 0.12 |
| " Western, including Pennsylvania and Ohio, | " | " | 0.06 | to | 0.08 |
| " Northern and Eastern, | Winter, | " | 0.10 | to | 0.12 |
| " Western, including Pennsylvania and Ohio, | " | " | 0.02 | to | 0.05 |
| " Southern Prime and Northern Fall, | Average, | " | 0.07 | to | 0.08 |
| Otter, Northern and Eastern, and North Western, according to size and color, | Prime, | " | 7.00 | to | 12.00 |
| " Pennsylvania, New Jersey, Ohio, and Western, | " | " | 4.00 | to | 7.00 |
| " Kentucky, Maryland, Virginia, Kansas, and vicinity, | " | " | 3.00 | to | 7.00 |
| " North and South Carolina, and Georgia, | " | " | 2.00 | to | 5.00 |
| " Sea, Alaska, | " | " | 60.00 | to | 125.00 |
| Opossum, Northern, cased, | " | " | 0.25 | to | 0.35 |
| " Southern, and open Northern, | " | " | 0.10 | to | 0.15 |
| Raccoon, Michigan, No. Indiana, Indian handled, dark, according to size and color, | " | " | 0.90 | to | 1.10 |
| " Northern Ohio, Illinois, Iowa, Wisconsin, and Minnesota, | " | " | 0.60 | to | 0.80 |
| " New York and Eastern States, and Northern Pennsylvania, | " | " | 0.40 | to | 0 60 |
| " New Jersey, So. Pennsylvania, Indiana, Illinois, Missouri, and Kansas, | " | " | 0.40 | to | 0.50 |
| " Maryland, Virginia, Kentucky, Arkansas, and Tennessee, | " | " | 0.30 | to | 0.50 |
| " North and South Carolina, Georgia, Florida, and Alabama, | " | " | 0.20 | to | 0.30 |
| Rabbits, cased, | " | " | 0.02 | to | 0.03 |
| Skunks, Prime black, No. 1, cased, | " | " | 1.00 | to | 1.40 |
| " White and Black, streaked, No. 2, | " | " | 0.65 | to | 1.00 |
| " Out-seasoned and very white, | " | " | 0.10 | to | 0.15 |
| Wolf Skins, Mountain Skins, large, | " | " | 3.00 | to | 4.00 |
| " " Prairie, average prime skins, | " | " | 1.00 | to | 1.25 |
| Buffalo Robes, in bulk, | " | " | 6.00 | to | 8.00 |

The quantities of these skins or pelts consumed at the present time are about as follows: Russia sable, not over 15,000; Kolinski, or Japanese sable, very few, the principal sale being in Europe and Asia; pine marten, or Hudson's Bay sable, not more than 125,000; the stone marten and fisher marten, though taken extensively here, are sold almost entirely in Europe; the mink is in much less demand, and probably not 200,000 pelts are taken annually, and half of these or more are sold in Europe. The ermine, or stoat, is very plenty, and perhaps 100,000 of the 400,000 taken annually are consumed here. The skunk skin is very popular here, as well as in Europe, and probably not less than 400,000 are taken annually; 3,000,000 muskrats are taken annually, and two-thirds exported. Of foxes, the silver fox is very scarce, not over 2,000 being taken; 6,000 or 7,000 blue fox, 10,000 cross fox, 65,000 white fox, 25,000 gray, 40,000 kitt, and 325,000 red fox. Beaver has again come into large demand, and skins of the larger and rarer animals are sold in great quantities. The seal skins taken in Alaska in 1880 are officially reported as 155,718, and of sea-otter skins as 3,575.

The changes in the fur trade in the past few years have been very great. Buffalo robes, once both common and cheap, are becoming scarce and dear with the rapid extermination of the buffalo. Chinese goat skins made up into robes are largely taking their place. The Russia and Hudson Bay sables, and the finest mink furs, once so precious and popular, are now in very light demand, and at prices comparatively low. The seal and otter furs, and the rare and costly sea-otter, have taken their place almost entirely among the higher priced furs. Muskrat furs are sold under various names, as river mink, marsh marten, American sable, and French mink, and are worth in a full set from $15 to $22. The French coney, called also French sable, is a French rabbit, colored brown, with black stripes through the middle of the skin, in imitation of mink and sable. A set of this fur, of best quality, costs from $10 to $20. Two sorts of squirrel furs are made up, and mostly for children's wear alone. One is entirely gray, and the other mixed gray and white, and their value is from $12 to $20 the set. The white fur worn by children is of the miniver and white coney. Fur overcoats for gentlemen are rarely seen in this country. A few have been introduced from Russia of great elegance, both sides being of rich fur, so that either might be worn outside. Among the novelties introduced into the fur trade since the war, we notice what are known as Astrachan furs. These are really lambskins, the finely-dressed pelt of the Assyrian or Astrachan lamb being the more common of these furs, and the grades called Persiani and silken Persiani being made from the newly-weaned lambs or the immature lamb taken from the body of the slaughtered mother. The finest specimens are very beautiful, and command a good price. The fur of the American skunk has made its appearance in the higher walks of fashion, under the more euphonious name of "black marten," or Alaska sable. It was introduced into Paris 16 or 18 years ago, and has become popular in this country. It is really a very beautiful skin, the black portions alone being used, and the fur is permanently deodorized by a process discovered by one of the members of the house of Gunther's Sons. But the most important and probably the most permanent addition to the list of popular furs is the seal-skin. It is mostly in demand for ladies' sacks or jackets, which are really very ornamental. It is dyed a soft, glossy brown (being the only valuable fur which is dyed), and trimmed with a rich brown silk. The intrinsic value of these garments and their attractiveness render it probable that they will continue for some years to be greatly in demand.

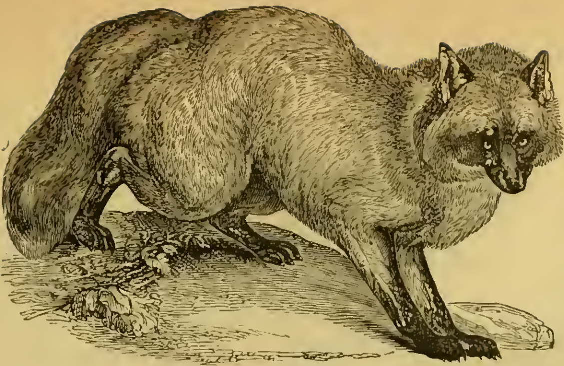
The mechanical processes to which furs are subjected are few and simple. The skins when stripped from the animals are merely dried in the sun, in order to protect them against putrefying. Those of small size are often first steeped in a solution of alum for more efficient protection, but the operation is objectionable, as the alum weakens the pelt. They are made up into bales, and are called peltry. When stored, it is essential to keep them perfectly dry; and to guard against injury from moths, camphor and tobacco are strewed among them; and they must be examined every few weeks, and each skin be beaten with a stick in order to cause the worms of the moth to fall upon the floor, when they are crushed by treading upon them.

The first process of the furrier is to soften the pelt. This is done, with the finer kinds, by placing them in a tub with a quantity of butter and trampling them. After stripping off the loose pieces of skin, they are again trampled in sawdust (that of mahogany being preferred), the effect of which is to remove the grease, and the cleaning process is completed by occasionally beating with a stick and combing the fur. The skins are now ready for the cutter, who from a large number cuts out pieces of various shapes, which are then sewed together to make up the various articles of fur dresses. Each cape, muff, etc., is thus made up of pieces from different skins, and the numerous seams are concealed on the outside by the fur itself, and on the inside by the lining. Recently there have been many improvements made in the way of machinery for the manufacture of furs, some of which are very ingenious. One of these is a sewing machine for sewing furs, which does its work better than it can be done by hand; another extracts the long hairs of the seal-skin without injuring the skin.

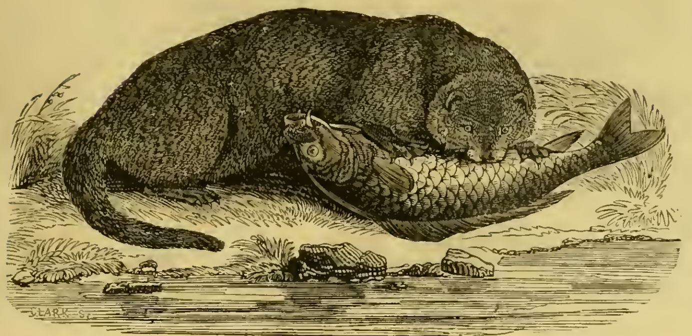
BISON, OR AMERICAN BUFFALO.


POLAR BEAR

BLACK BEAR.

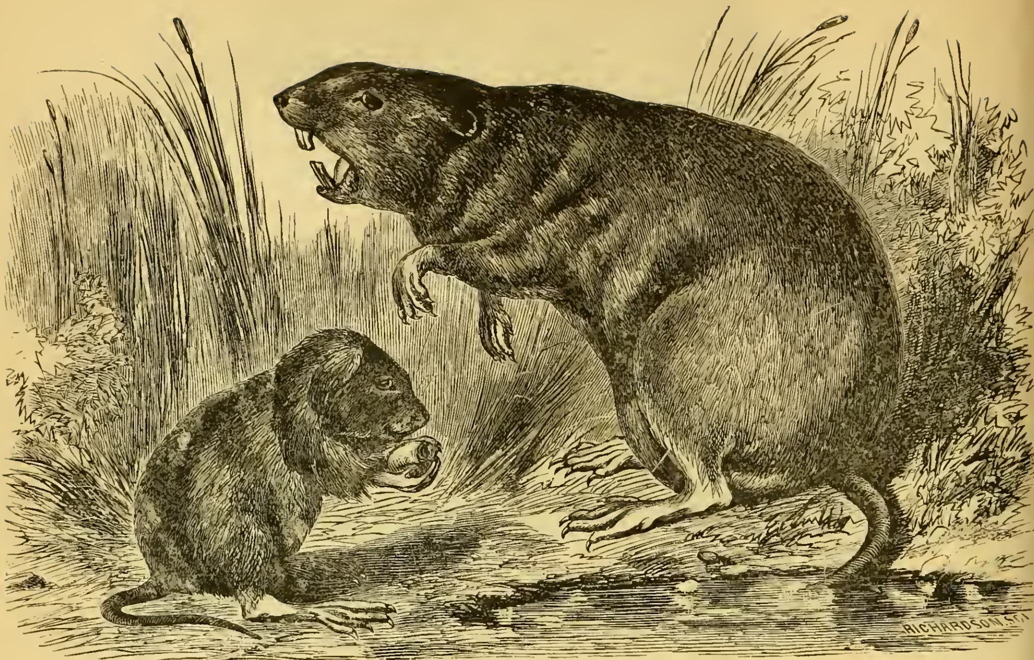


FOX.



OTTER.

BEAVERS.




MUSKQUASH.

AMERICAN SABLE.

Furs that are to be used for felting require first the separation of the long hairs. This is effected after the skins have been split, scraped, and pressed, by either clipping them down to the length of the short hairs, or pulling them out one by one as each is seized between a knife-blade and the thumb. When carefully trimmed and pressed, the skin is well moistened with water, and being held upon a board of willow wood, the fur is cut off close to the pelt by means of a sharp, rough-edged knife. The whole clipping is kept in one fleece by means of a piece of tin held in the left hand, and up which the fur is slipped as it is cut. The rabbits' fur imported for the hatters is received in these light, loosely cohering fleeces, each being the fur of one animal. The skins of the beaver and nutria require much more thorough cleaning to remove the fat from the pelt and the grease from the fur, as by repeated scrubbing with soap and hot water. The thick, closely-matted fur of the former has been successfully cut by machine knives, an operation that has always failed when applied to the more uneven and thinner kinds of fur. Some chemical preparations have been used to separate the fur from the pelt, but they are generally found to be objectionable, as they destroy in part the felting property.

# HATS.

## CHAPTER I.

### EARLY HISTORY—MANUFACTURE—IMPROVEMENTS.

From an early period in the history of manufactures in the United States, the production of hats appears to have been prosecuted with considerable success. As far back as the year 1732, the business was so successfully carried on in New England and New York as to lead to complaints among the hatters of London, and representations of the injurious effects upon the trade were in consequence made by the London Board of Trade to the House of Commons. Being the most conspicuous article of dress, the hat naturally was an object of particular solicitude, and much more latitude was allowed in giving to it peculiar and fanciful forms than at the present time. And if our fathers failed to produce fine specimens of manufacturing skill, we must admit that, in adopting the graceful forms of the high Spanish hat, with its rounded brim, and ornaments of plumes, or loops and tassels, they certainly excelled us in their appreciation and selection of pleasing shapes, instead of such stiff and awkward forms as those of the fashionable hat of the present day. There was, however, with them, quite as great a variety of hats as with us, both in material and in figure. The common hats were of rough felt, usually of wool, or of wool and fur—sometimes of fur alone—and the practice was early introduced of covering the wool body with a plating of fine fur, felted by hand into the outside of the coarser material. The body was stiffened or not with glue, and sometimes water-proof stiffened with gum shellac. The round crowns of the early part of the century had given place, in the better kinds of hats, to flat tops, and the broad brims of some were turned up and looped, first on one side, then on another, and at last on the third, till it became the regular three-cocked hat. This, from being a fashionable hat, finally came to be appropriated to military officers, by whom it is still worn as a badge of rank. The Quakers alone adhered to the old broad brims, making it, it is said, a point of faith not to wear a button or a loop, and wore their hats "spread over their heads like a pent-house, darkening their outward man to signify they have the inward light." In the other extreme there were fashionable hats, like ladies' bonnets of the present time, too small to serve as a covering for the head; such a hat was conveniently carried under the arm, and in fashionable calls furnished a pleasant diversion to its owner, who twirled it upon the head of his cane.

Many of the soft hats of our ancestors were, no doubt, very fair articles of hand workmanship. They possessed abundance of material, and used the choice fur of the beaver more lavishly than hatters have of late been able to afford. Their mode of felting was the same as that now practised where machinery is not introduced, and their methods of shaping hats over blocks, or "sizing," were probably as skilfully conducted as at the present time. But in the production of the stiff pasteboard hats, covered with a sheet of fur or other material, the processes in use were comparatively rude, and have so continued down to within a few years past. Within our own recollection, the hatter in almost every village made the hats he sold, felting his own materials and forming the bodies over his blocks, and covering with them the stiff and clumsy cylinders of pasteboard, shaped, as near as might be, to the prevailing forms of the day. The fur of the musquash and beaver were used, often plated upon a body of lamb's wool; and the choicest beaver hats were plated with the finest fur of the animal, taken from the belly and cheeks. This, too, came to be used upon bodies of rabbits' fur, of which the so-called beaver hats at last were chiefly made; and as beaver became scarce, nutria, from a South American animal of this name, was very generally substituted for it. The hatter was provided with dyeing kettles, in which the complex materials of his hat bodies were brought to a uniform black shade; and there was a variety of apparatus for steaming, shaping, and finishing, all of which involved laborious hand-working, and more or less mechanical skill, to produce the small number of hats required by the men and boys of the village.

Within a few years a complete revolution has been effected in this business. Machinery has been almost wholly substituted for hand labor in preparing the materials of hats, and this is now done upon an immense scale in a few of the large cities, whence the hat bodies, or the finished hats, are sent for the supply of the country. The effect of this has been to furnish hats of uniformly better quality than were made by hand, at greatly reduced cost, and to carry the manufacture to such perfection that the American hat is now distinguished as the lightest and best produced in any country. In England, the American is often recognized by the excellence of his hat. For this we are in part indebted to the greater dryness of our climate, the moisture of England rendering it necessary to give more body and stiffening to the hats exposed to its influence. This is not so much the case in France, and hats there approach more nearly the quality of our own.

In Portland, Boston, and small towns of eastern Massachusetts, felted wool hats are made largely, and in New York city, Brooklyn, Newark, N. J., Norwalk, Bethel, Redding, and Danbury, Conn., and Philadelphia, felted hats of fur are made upon an immense scale in numerous establishments; and it is stated that the commission houses and agencies engaged in this trade sell over 8,000,000 hats annually.

The business in stiff hats is a distinct branch of the trade, and their manufacture is extended through several different establishments. The making of the bodies was for many years almost monopolized by Henry A. Burr & Co., of New York city, and supplied by them to agents in a few other cities. They received from the hatters, who buy of the importers, lots of rabbits' fur, the chief supplies of which come from towns near the German Ocean, as Frankfort-on-the-Main, Brussels, etc. Some of poorer quality was also obtained from Virginia and North Carolina. The fur of each lot was mixed together, and to every 4 or 5 ounces (the usual quantity for a felt hat) $\frac{1}{4}$ to $\frac{1}{2}$ an ounce of the finest carded cotton was added; and at the same rate for the lighter fashionable hats, the weight of which is about 3 ozs. Picking machines, revolving with great velocity, and creating, in a capacious box, a powerful current of air, caused the fur to be well mixed, the operation being repeated to make it thoroughly effectual. The long hairs and bits of pelt were then separated by what was called the blowing machine. This consisted of pickers, which revolved several thousand times in a minute, and struck out the coarse hairs and heavy particles, which fell upon a screen, while the light hairs were blown upward and carried forward to another com partment, where the same process was repeated. The screens were kept in agitation, and the coarse particles were finally shaken off at the feet of the man who fed the machine, and by him they were again passed through to save the fur that adheres to them. The dust escaped through the perforated copper covering of the machine, and the clean fur was delivered at the extreme end in a fine flocculent condition, readily worked into a mat by felting, as was shown by rolling a little of it between the fingers. In the large factory of the Messrs. Burr & Co., about 30 of these machines were kept in operation, and the quantity of fur prepared by them was enough for about 10,000 hats daily. This number was produced daily for sixteen or seventeen years. Two steam-engines were employed by turns, one of which is of 400, and the other of 200 horse power.

The fur used to be felted altogether by the hand process: but various improved methods have been devised for lessening the labor; and the best of these are of American origin. By the process invented by Mr. Thomas Blanchard, of Boston, the fur was made to collect upon a fine wire gauze, and there take the form of a matted ribbon, by exhausting the air beneath so as to create a strong current of air from the receptacle in which the particles of fur were kept floating in the air. This ribbon being wound around a double conical block, of the size of two hat bodies, was then joined along the overlapping edges by rubbing. The method of Messrs. Burr & Co. was an improvement upon this, perfected by Mr. Henry A. Wells and Mr. Burr. A cone of sheet copper, considerably larger than a hat body, punched full of small round holes, was set upright, and made to revolve slowly upon a vertical spindle. An exhausting fan under it rotated about 4,000 times in a minute, causing a strong current of air to draw through the holes from the outside. Against the cone was the mouth of a sort of trunk, or long box, in the opposite end of which the fur was fed in quantities just sufficient each time for one hat body. The fur was taken up from the feeding apron by a cylindrical brush, and thrown forward by the rapid revolutions of this, which also created a current of air that blew the fur toward the mouth of the box. From thence it was seized by the exhausting current, and drawn down upon the cone, covering this completely while it was turning round sixteen times. The workman standing by picked off any coarse particles that fell in with the rest, and as soon as the deposit was completed he laid a wet cloth over the cone, and placed over all a loosely-fitting metallic cover. He then lifted off the whole, and immersed it in a tank of hot water, replacing a new cone immediately, to receive the next hat-body. The effect of the hot water was to make the particles of fur cohere more closely together. When taken out of the water the mat was placed in a piece of blanket, and worked by the hand upon a table. It was then squeezed, to press out the water, and folded, to be pressed with others, and made up with them into bundles for the hatters. The shape of these bodies was that of a wide, opened-mouthed bag, of a size much larger than the hat. They were very soft, tolerably strong, and were afterward reduced to the required dimensions and shape by the process called "sizing," which was done by the makers of felt hats for themselves, and for most of the larger manufacturers of silk hats by intermediate establishments specially devoted to this object.

The patent of Messrs. Burr & Co. expired in 1869, and though their hat formers are still in use very largely and highly esteemed, those of the Gill and Yule patents, which are still in force, have also a great popularity. There are probably not less than 13 or 14 million hat-bodies formed on these three formers. By their use from 400 to 450 hat bodies can be formed on each machine in a day, and this requires only three men and a boy, while by the hand process the same persons could not have made more than sixteen in a day. The further processes for completing the manufacture of stiff hats, which fifteen or twenty years ago were mostly performed by hand or with very little machinery, are now almost wholly conducted by ingeniously contrived machines. There are a great variety of these machines for sizing, wringing, stiffening, cutting, blocking, stretching, dyeing, washing, drying, pouncing, finishing, trimming, sewing, binding, and flanging the hats. All these machines have so expedited and perfected production that the American stiff and soft hats have no superior in the world. There are a small number of stiff hats, mostly of the "Derby" pattern, imported from England, not because they are of better quality than the American, for they are not equal to them, but because they are of higher price, and it is deemed more respectable by a snob who has money to wear an imported hat and pay a higher price for it, even if it is of inferior quality to the home-made product. For several years past many of the ladies' hats have been made of felt, either what are known as soft hats, or the round hat varying little from the style known as the Derby. The best quality of soft hats, when handsomely trimmed, made a very pretty, though not very enduring hat. The last were called French felts, but most of them were really made here. Within the past two years, beaver soft hats, with wide brims and turned up on the sides, have become very popular with the younger ladies. They are quite expensive, and have, perhaps, a rich though not a graceful look.

Those who are enamored with foreign articles, and think there is nothing worth having unless it comes to us from over sea, can be partially gratified by purchasing and wearing the silk, or as it is called very often, "the stove-pipe" hat. These hats are, it is true, put together here, but the silk plush, the shell of shellacked cambric which forms the body, and all the trimmings and linings which are used, except the manufacturer's name in the crown of the hat (and even this is printed usually on imported silk), are imported from France, and the wearer of a first class silk hat can have the satisfaction of knowing that the duties paid on that piece of head-gear are about $1.12½—a pretty heavy tax to pay for what might just as well be produced here at a much lower price. It is true that some attempts to produce the plush here have failed, but our silk manufacturers are too ingenious to give up, even after half a dozen failures; and they would succeed were it not that the hatters prefer to use the imported articles for the sake of giving their goods the name of French hats. The silk hat is in all respects inartistic and ungainly, an abomination in the eyes of persons of good taste, and deserves to be abolished.

This business is carried on in several large establishments in New York, Philadelphia, and other cities; and from these the fashionable hatters are supplied with hats made to order and marked with their names. The country trade is also supplied from the same source, but with hats rather heavier and stronger than those made for city wear. The latter weigh when finished only about three ounces, and are not usually expected to continue in wear more than a few months; not because of their becoming shabby in this time, but because slight changes in the form are continually introduced, which wearers must adopt to keep in the fashion; and in the city there is more disposition and means for always wearing the latest and most outré fashion, whatever its cost.

The manufacture involves a variety of processes, each of which, after the most economical system of division of labor, is conducted by workmen specially devoted to this alone. By one set of hands the soft shells are first subjected to the operation of waterproof stiffening. They are dipped one at a time in a weak solution of shel lac, then slipped over a block, and partially brought into shape by rubbing with the hands. The brim and tip (or edges of the top) are then brushed over with a thicker coating of the gum to give additional stiffness to these parts. When dry, a hot iron is applied, which has the effect on cooling of giving greater hardness and solidity to the material. The next application is a coating of fine glue or gelatine, the object of which is to prevent the varnish of seed-lac, which is next laid on, from striking in. The hats are after this taken to the finishing room, and here are first shaped and trimmed to the exact pattern sent with the orders from the retail hatters. In this operation brass gauges of a variety of forms are made use of, by which the exact dimensions and shapes required are secured without the slightest deviation. The silk plush has been in the meantime already prepared by sewing a circular piece for covering the top, with great nicety to the piece which surrounds the body, the two edges of which meet in a line up and down the side of the hat. The brim is covered by a separate piece above and below, and the edges of these pieces are afterwards concealed under the binding and the band. A hot iron is applied in order to smooth the plush and cause it to adhere to the varnish, which is softened by the heat of the iron. After being lined and trimmed, the hat is finally smoothed and shaped with a hot iron, and the precise curve required is given to the brim, the finishing of which demands the skill of a practical workman.

Another large class of hats are made of palm-leaf, straw, grass, split rattan, and, in some cases, of horsehair or filaments of whalebone. We class these together because they are all braided, though by different processes. They are made of a great variety of materials, by different methods, and in different states and countries.

The palm-leaf hats are made of split fibers or narrow strips of the leaves of the fan palm, and are mostly produced in Massachusetts and eastern Connecticut. The braiding is mostly done by young girls, and largely in their own families in the country. When braided they are taken to the factories, examined, pressed, boxed, and sent to market. The straw hats are a better grade, and are braided of many patterns. The braiding is done here to a considerable extent, but most of the ladies' straw hats, and a portion of those worn by men, are imported. Dunstable and its vicinity, in England, are famous for this class of work, and much is also produced in Switzerland and Germany. The Manila hat, so called, is really a straw or grass hat imported from the Malayan Archipelago. They are just now the rage, and the importation is mostly in the hands of one or two houses. The Panama and Guayaquil hats, with some from Maracaibo, are braided from a grass prevalent there, and are the most valuable of all the hats of this class, those called "Panama" bringing the highest prices. Very few are now imported. The Leghorn hat, a very fine braid originally plaited in Italy and worn by both sexes, is not in vogue now, and but few are imported. Hats of the other materials named, though at one time very popular, are not now in demand. In 1880, there were only 23,094 straw, palm-leaf, and Manila hats imported; the value was not given.

Another class of hats and caps largely manufactured includes those made of cloth, fur, or skins of wild animals having the hair on. This branch of the manufacture is extensive, and is so widely diffused throughout the country that it is very difficult to obtain any statistics of it approaching accuracy. Hats, caps, and bonnets made of wool, fur, and silk were imported in 1880 to the number of 198,639, but their value was not stated.

Our estimate of the annual production of hats and caps of all materials can be only a guess, the special agents of the census of 1880 have thus far been completely foiled in their efforts to obtain accurate reports. The census statistics of 1870 were as follows:

Establishments, 483; hands employed, 16,173; viz., 8,847 men, 6,301 women, 1,025 youths; capital, $6,489,571; wages, $6,574,490; materials, $12,262,107; annual product, $24,848,167. It is safe to say that all these items, with the possible exception of hands employed and wages paid, have more than doubled during the decade. The very large introduction of machinery has increased the production enormously without a corresponding increase in the number of hands employed.

# INDIVIDUAL INDUSTRIES.

The great progress of this country, as evinced in the developments of the preceding articles, is manifest to the civilized world, in the position which the country occupies among the nations of the earth. If we have followed the progress of each leading branch, from small beginnings up to the magnificent results that they now display, it has been to show that these results, great as they are, are but the preliminary to that career which the future promises. It is to be borne in mind that the capital of the country had to be created, and that the large enterprises could be carried out only by an accumulation of capital that grew as it was applied. The manufactories, the mines, the furnaces, the railroads of the country, were nearly all carried on by associated capital acting through corporate bodies. Underlying those vast undertakings, however, are the broad fields of individual industry, where every man, depending only on his own skill and perseverance, not only, as it were, created an industry, but devised the means of making it successful. The inventive genius of the people has been systematically applied to the improvement of qualities of goods made, at the same time that the cost of manufacture has been cheapened. The field of individual industries may be explored with quite as much interest and admiration as those which have been opened by the application of incorporated capital. The wonderful results that have been obtained have been accompanied by the fortunes of the enterprising men that have produced them. It is the case sometimes with corporate capital that the greatest enterprises are carried out successfully for the public interests, while the capital invested in them has been sunk. In the case of individual operation, a combination of mechanical inventions, of industry classified, of raw materials judiciously assorted, and of directing skill, produces articles that, before unknown or appreciated by the public, have become necessities, and the demand rewards the genius and judgment of the manufacturer with a fortune. In almost all cases, but little money capital was possessed at the commencement, but there was a better capital than mere money, in the self-reliant genius of the indomitable American. These individuals have remodelled old manufacturing processes with improvements, and created others, giving employment to thousands of workers, and creating interchangeable values for the great natural products of the country; in other words, finding a market for labor which would otherwise not have been available. In the present article we will explore a number of the leading industries of this nature.

## BUILDINGS AND BUILDING MATERIAL.

Among the marvellous evidences of the advancing wealth and luxury of the American people, the multiplication and improvement of dwellings are very conspicuous. The official figures in relation to the numbers and values of dwellings in the country are indeed not very abundant or very precise. There are materials, however, which, put together, give a pretty accurate estimate of the enormous investments in dwellings.

In 1798 the number of dwellings and their value in all the states, was given in the tax-list laid before Congress. The values given in the official tax list at the end of the last century not only apply to a class of dwellings far less costly than the average of those now in vogue, but it was at a time when money or capital was of a higher value relatively. The number and value of the houses then reported may be compared with the number of dwellings reported in the United States census of 1860 and 1870, as follows:—

Number and Value of Dwellings in the United States.

| | 1798. | | 1860. | 1870. | 1880. |
|---|---|---|---|---|---|
| | No. Dwellings. | Value. | No. Dwellings. | No. Dwellings. | No. Dwellings. |
| Maine, | part of Massachusetts. | | 115,933 | 121,953 | |
| New Hampshire, | 11,142 | $4,146,938.90 | 65,968 | 67,046 | |
| Vermont, | 5,437 | 1,558,389.36 | 62,977 | 66,145 | |
| Massachusetts, | 48,984 | 24,546,826.46 | 205,319 | 236,473 | |
| Rhode Island, | 7,037 | 2,984,002.87 | 27,056 | 34,828 | |
| Connecticut, | 23,465 | 8,149,479.28 | 83,622 | 96,880 | |
| New York, | 33,416 | 25,495,631.39 | 615,888 | 688,559 | |
| New Jersey, | 19,624 | 9,149,918.84 | 116,353 | 155,936 | |
| Pennsylvania | 51,772 | 29,321,048.33 | 515,319 | 635,680 | |
| Delaware, | 5,094 | 2,180,165.83 | 19,288 | 22,577 | |
| Maryland, | 16,933 | 10,738,286.63 | 106,137 | 129,620 | |
| District of Columbia | .... | ........ | 12,338 | 23,308 | |
| Virginia | 27,693 | 11,248,267.67 | 207,305 | 224,947 | |
| North Carolina, | 11,760 | 2,932,893.09 | 129,585 | 202,504 | |
| South Carolina, | 6,427 | 5,008,292.93 | 58,220 | 143,485 | |
| Georgia, | 3,446 | 1,797,631.25 | 109,069 | 236,436 | |
| Florida, | .... | ........ | 14,132 | 41,047 | |
| Alabama, | .... | ........ | 96,682 | 198,327 | |
| Mississippi, | .... | ........ | 61,460 | 164,350 | |
| Louisiana, | .... | ........ | 63,992 | 150,427 | |
| Texas, | .... | ........ | 77,428 | 141,685 | |
| Arkansas, | .... | ........ | 56,717 | 93,195 | |
| Tennessee, | 1.030 | 286,446.83 | 147,947 | 220,816 | |
| Kentucky | 3,339 | 1,139,965.13 | 164,161 | 224,969 | |
| Missouri, | .... | ........ | 181,169 | 292,769 | |
| Illinois, | .... | ........ | 304,732 | 464,155 | |
| Indiana, | .... | ........ | 256,946 | 318,469 | |
| Ohio, | .... | ........ | 425,672 | 495,667 | |
| Michigan, | .... | ........ | 150,952 | 237,036 | |
| Wisconsin, | .... | ........ | 154,036 | 197,098 | |
| Iowa, | .... | ........ | 131,663 | 219,846 | |
| California, | .... | ........ | 100,328 | 126,307 | |
| Minnesota, | .... | ........ | 40,926 | 81,140 | |
| New Mexico Territory, | .... | ........ | 21,945 | 21,053 | |
| Oregon, | .... | ........ | 12,277 | 19,372 | |
| Montana, | .... | ........ | .... | 9,450 | |
| Arizona, | .... | ........ | .... | 2,822 | |
| Nebraska, | .... | ........ | 7,811 | 25,144 | |
| Nevada, | .... | ........ | .... | 12,990 | |
| Kansas, | .... | ........ | 33,278 | 71,071 | |
| West Virginia, | .... | ........ | .... | 78,854 | |
| Colorado | .... | ........ | .... | 10,009 | |
| Dakota, | .... | ........ | .... | 3,231 | |
| Washington Territory, | .... | ........ | .... | 6,066 | |
| Wyoming, | .... | ........ | .... | 2,379 | |
| Utah Territory, | .... | ........ | 10,763 | 18,290 | |
| Total, | 276,549 | $140,683,984.77 | 4,969,692 | 7,042,833 | |
| No. of Churches, | .... | ........ | 54,009 | 72,459 | |

The national census of 1870 did not give the value of the dwellings, but the state census of New York for 1875 gave not only the dwellings, but their value and material of construction. By that census it appears there were in New York 728,688 dwellings, worth $2,465,033,634, or an average of $3,383 each. The average for stone houses was 21,189. These are mostly the better class of houses belonging to the wealthy inhabitants of towns. The whole number of these is 19,718, of which 10,462 are in New York city, and worth $338,066,000, or an average of $32,314 each. In the remaining portion of the state the stone houses are 9,256 in number and $79,734,721 in value, or an average of $8,614 each. The New York stone houses and hotels are exceptions, being the most luxurious display of the wealthy few. The number of brick houses is 98,298, average value $10,680; and of frame houses, 598,013, average value 1,666. If, then, we assume $1,200 as the average value of the dwellings in the whole Union, the result for 1870 will be an aggregate of

$8,451,399,600 invested in dwelling-houses, being an increase of $8,310,715,675 in 72 years, or $115,426,606 per annum for 72 successive years, in addition to the $354,-483,581 invested in churches. The sums absorbed by other public buildings are not specified. The building which has been done from 1870 to 1880 by far exceeds that ratio. Thus the New York state census gives the number of dwellings in 1875 at 728,688, against 594,045 in 1865, an increase of 434,643, or almost 23 per cent. in ten years. Comparing dwellings to the population, the results are as follow:—

UNITED STATES.

| | No. | Free population. | Persons to each house. |
|---|---|---|---|
| 1798,......... | 276,659 | 4,412,884 | 19.00 |
| 1850,......... | 3,362,337 | 20,059,399 | 5.94 |
| 1860,......... | 4,969,692 | 28,000,000 | 5.53 |
| 1870,......... | 7,042,833 | 38,558,371 | 5-47 |

NEW YORK STATE.

| | No. | Population. | Persons per house. |
|---|---|---|---|
| 1798,........... | 33,416 | 586,754 | 19.00 |
| 1850,... ....... | 473,936 | 3,097,394 | 6.53 |
| 1855,........... | 522,325 | 3,466,212 | 6.64 |
| 1865,........... | 594,045 | 3,827,818 | 6.44 |
| 1875,........... | 728,688 | 4,698,958 | 6.60 |

The number of persons to a dwelling was greater in New York in 1870 than the average of the Union, and that number slightly increased; in the next five years that increase was again narrowed to the city of New York, where the crowd of foreign arrivals and large hotels and boarding-houses raised the number of persons to 14.6 for each house.

The population of Philadelphia and the number of dwellings are as follow:—

| | Population. | Dwellings. | Persons per dwelling. |
|---|---|---|---|
| 1850,........... | 408,762 | 61,278 | 6.10 |
| 1860,........... | 565,529 | 89,632 | 6.05 |
| 1870,........... | 674,022 | 112,366 | 6.01 |

In Philadelphia, the increase of dwellings per cent. appears to be greater than the progress of the population.

The general result in the Union is a house for every family, and these families average 5½ persons each. From these figures it is apparent that the number of houses in the Union progresses in the ratio of its inhabitants. The very close approximation of the number of persons in a family to the number of persons to a dwelling demonstrates this very conclusively; thus the number of persons to a family, in 1850, was 5.56; in 1860, 5.28; in 1870, 5.09. The number of persons to a house, in 1850, was 5.94; in 1860, 5.53; in 1870, 5.47. It should be remarked that in 1850 only the dwellings and families of free persons were thus reported, and the inclusion in 1870 of freedmen may have slightly affected the ratio; there were other causes, however, which had perhaps a greater influence. When the statistics of families and dwellings for 1880 are completed we may expect a still farther reduction of the ratio, though not of a large amount.

In the cities the cost of building has more than doubled in ten years. This is a necessity of increasing numbers, and provides nothing for reconstruction, or churches, or public buildings. This item of house-building in an increasing country stands out in contrast to the demand in the same line in the old countries of Europe. Some of the old cities there were built 500 to 1,000 years ago of solid masonry. There is not only no continuous demand for labor and capital to provide new dwellings to accommodate swelling numbers, but the empty dwellings frequently give melancholy signs of a departing population.

In the United States, not only does this vast annual demand for 287,000 new houses exist, but every year brings improvements in the style of construction and the luxuriousness of accommodation. The simple frame buildings that generally spring up on the outskirts of cities, are, before they are yet old, required to give place to brick buildings, since the spreading population carries the municipal laws which forbid wooden structures over larger limits. The brick buildings that supplant the frame must also be more substantial, since the same fire laws also prescribe the thickness and stability of the walls. Wealth follows with its more pretentious style, and brown stone or marble palaces rear their stately fronts on what was lately an open lot. With the improved style of houses there is a constant ambition to occupy a "modern house," or one with the "modern improvements," which may be enumerated as, warming apparatus, whether by hot-air, water, steam, or gas; the water-pipes in all the rooms, connecting with the cooking-range for facility of heating; water-closets and bath-rooms connected with street sewers to carry off the waste water, bells, speaking-tubes, telegraphs, ventilation, burning-gas, dumb-waiters to communicate with different floors, and all the luxury of arrangement and embellishment which makes a modern private dwelling so far in advance even of the fairy palaces of the Arabian Nights' Entertainments. There is a natural desire on the part of all to obtain, as circumstances will permit, a better house, and if these are not built in the substantial manner which in Europe defies the ravages of time, they are in the fashion and luxury of the day, and may be altered or reconstructed as fortune changes. The railroads that give access to the neighborhood in such a manner that a business man may take his breakfast at 7½ o'clock, ride forty miles, and be at his office before bank opens, has, so to speak, carried city houses into a broad circle of country, and "villas" rise rapidly from the soil, also provided with all city improvements. Thousands of miles are within this influence. In sections which, a quarter of a century since, were shadowed only by the native forests, in which the scream of the panther and the gleam of his eyes startled the benighted traveler, streets of marble fronts now emit the glare of gas and the latest creations of the opera. In all directions the gaze of the traveler falls upon new creations, where lumber, brick, stone, and lime are combining into a dwelling or a factory, a school-house or a church.

The increase of houses being proportioned to the increase in the numbers of the people, their value has risen in the ratio of their growing wealth. It is remarkable that the country, in all its sections, abounds with the best materials for all description of dwellings, and yet these materials were very slowly discovered. For long years the bricks with which the best houses of New York were built were brought from Amsterdam in those stately old droguers which, on their arrival in the bay of New Amsterdam, were regularly dismantled and laid up over the winter, setting out on their homeward voyage with the early spring. The bricks were probably used as ballast, but even then the cost of a house so built was something important. The early houses of the settlers were log huts, but subsequently frame houses were raised by the more ambitious, and, as wealth increased, those "shingle palaces" that became famous in the stories of New England manners, began to dot the country. In the cities, frame houses were the rule down to a comparatively late date, when the fire laws forbade the erection of wooden tenements within certain districts. The abundance of timber not only for building purposes, but for fuel, was a great advantage to the country. But as the population increased, the inroads upon it became very heavy, and the forests were rapidly thinned out. The annual consumption exceeded the growth, according to the estimates of the most experienced lumbermen, by about 30%, and this notwithstanding that coal came to supply the drafts made for fuel, and the substitution of bricks for city houses. Lumber for building was for many years brought from Maine, northern New Hampshire, and Vermont, but the pine, spruce, and hemlock from those sources is now nearly exhausted. Moderate quantities of pine and hemlock are obtained from central New York and Pennsylvania, but the greater part of the soft pine and hemlock, and much of the hard woods, come from the upper and lower peninsulas of Michigan, Canada, Wisconsin, and Minnesota; black walnut, cherry, ash, and white oak from the Alleghanies in western Pennsylvania, Maryland, West Virginia, East Tennessee, North Carolina, etc.; hard pine from North Carolina, Georgia, Florida, and Alabama. Most of the lumber of Minnesota goes west, and there are forests of considerable extent in Montana, Wyoming, and Idaho, and in eastern Utah, which will be needed for the consumption of those territories, but the supply for the Pacific coast must come from Oregon and Washington, and the mountainous districts of California; and eventually, perhaps, from Alaska. The lumber of the Pacific coast is of excellent quality and of great size, the red cedar, fir, spruce, and various kinds of pine, surpassing the timber trees of any other country.

The total product of lumber sawed in the United States in 1870, was 12,755,543,000 feet of lumber, 1,295,091,000 lath, and 3,265,516,000 shingles, besides $10,473,681 worth of staves, shooks, and headings, a total value of $210,159,327. Add to this the amount of planed lumber, $42,179,702, and the production of sash, doors, and blinds, $36,625,806, and we have a grand total of $288,964,835. This was an increase of almost three-fold on the production of 1860. The lumber report of the census for 1880 is not yet completed, but enough is known to demonstrate that the increase has been greater than in the preceding decade.

The reasons for this vast increase in the consumption of lumber are not far to seek. The railways, which have more than doubled since 1870, use an enormous quantity of timber for ties and stringers, an immense amount for stations, freight houses, and shops, and in some sections still more for fuel for the locomotives. The mines, where of any extent or depth, require timbering very heavily, and all of them need lumber and timber for reduction works, flumes, and dwellings, the dwellings, churches, school houses, stores, and workshops for ten or twelve millions of people who have settled in the west, require the felling of such vast areas of forest that serious alarm has already been excited lest our country should be denuded of its forests before the close of the present century.

With the vast supply of lumber and timber to meet the demand for building purposes, it followed that inventions for preparing them for the builders' use would not fail to make their appearance. Some of the inventions, like the planing machines introduced in 1837, are of great value and importance. Circular saws, scroll saws, and a crowd of inventions bearing upon every part of the work, have wonderfully facilitated the work of the carpenter and joiner. The blinds, sashes, doors, window-frames, have become separate trades, each of which supplies its portion much cheaper and more perfect than formerly.

Two-thirds of the better class of houses in the largest cities are built, as the phrase is, "on speculation." A builder becomes possessed of a number of building-lots, and borrows money on them to build a block of houses, from four to fifty houses being undertaken at a time. When they are partially completed, more money is borrowed on them on mortgage, and when finished they are sold as speedily as possible, and generally on moderate terms. The strong competition compels the builders to make the houses attractive in appearance, and all the so-called modern improvements are introduced into them; but with few exceptions, the work which is out of sight, the plumbing, the staying of the floor beams, the party and interior walls, etc., etc., are of inferior work and done by incompetent workmen. Houses are also made for exportation, as well of iron as of wood, as in the case of the early times of San Francisco, which received many of its dwellings from New York. The settler on the new lands of the west is now not always required to plunge into the wilderness and rear his first shelter from logs, but may have his house sent from Chicago or other cities by railroad, and put up to await his coming. This is not practiced as much now as a few years ago, however, because lumber is much dearer than formerly, and these ready-made houses do not protect the settler from the severe winters so well as a "sod-house" or even a "dug-out." Log cabins, on "the plains," are not to be had.

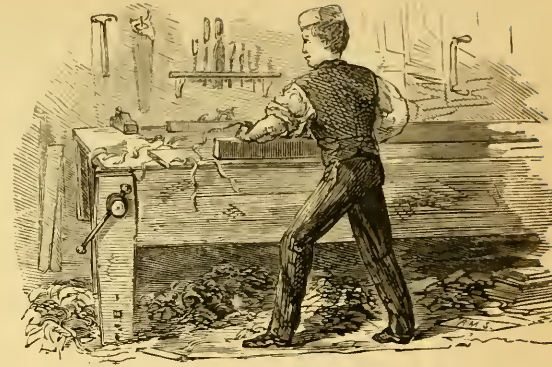
With the settlement of the western country, the saw-mills are kept busy in supplying lumber. The most extensive of them are round the Falls of St. Anthony, where about 200,000,000 feet of logs come down in the spring from the waters above. These logs are manufactured into lumber at the immense saw-mills at St. Anthony and Minneapolis. These mills, in 1880, manufactured 191,882,349 feet of lumber, 74,891,550 shingles, 33,505,450 lath, besides large quantities of staves, shooks, and headings. Ninety per cent. of these products were shipped, mostly to the west. At the extreme south, lumber is also produced. About 50,000,000 feet are shipped from Pensacola to the Atlantic and Gulf cities, in addition to the large quantities used in the town. The Dismal Swamp Canal at Norfolk delivers 6,000,000 feet of plank per annum, and 75,000,000 shingles, 800,000 feet of timber, and 12,000,000 staves.

The material for dwelling houses is thus liberally supplied at the leading points to and from which means of communication have been so extensively provided. Most country houses are built of lumber, or frame houses. In the cities the majority are of brick, and in New York and Brooklyn houses are still standing built from the small yellow and black brick brought from Holland. Brick clay is found in most of the states, but not of the same quality. The best brick are from Philadelphia and Baltimore, but Milwaukee is famous for its straw-colored bricks. This color results from the absence of one of the oxides of iron in the clay. Some Milwaukee bricks were brought to New York city for the construction of Trinity Building, head of Wall street, and they assimilate in color to the old Holland brick, also "far fetched and dear bought."

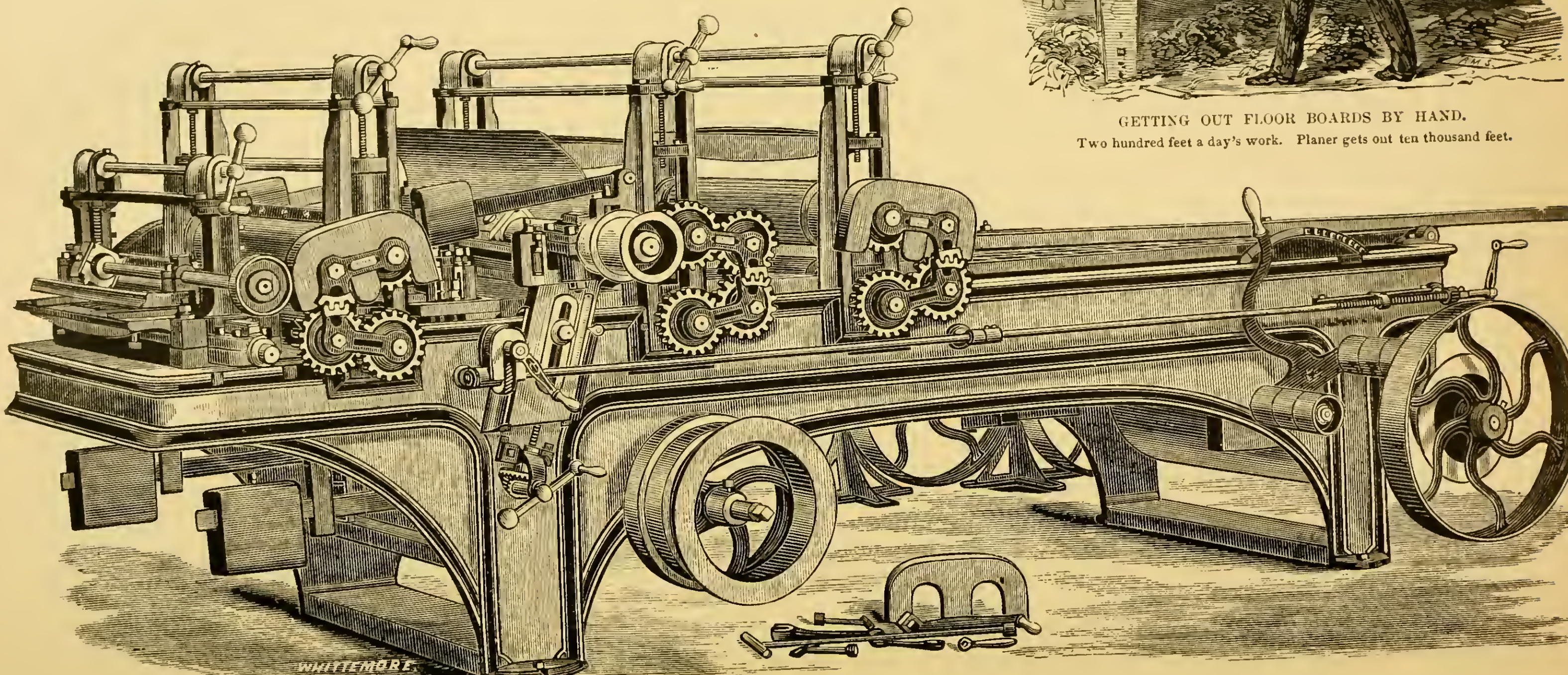
In the manufacture of the brick the clay is obtained as pure as possible; but it must be exposed for some time to the air and weather, which soon disintegrates its particles, and fits it to be kneaded into a mass. The clay is then soaked in a tank. The kneading was formerly done by animals or the naked feet of men, which machinery has superseded. The clay is now first ground in the pug-mill, which is a tub in which revolve on a shaft blades that cut and knead the clay as it is fed in from above, and passes out at the bottom. It is then cut into pieces and stacked for use. The old hand mode of moulding was to throw the clay into the mould by force and then scrape off that which was superfluous. The labor of this process was reduced by causing the moulds to receive the clay from the mill in successive sets. It is obvious that the clay must be cleaned from all stones, sticks, etc., that would disfigure the brick. When the bricks are moulded they are dried. For this purpose a level yard is prepared, and bricks are brought in the moulds, which are removed, leaving the bricks to dry, a longer or shorter time, according to circumstances. If the bricks are not thoroughly dry they will crack in baking. For the purpose of baking, the bricks are piled one upon the other, to make the kiln or clamp. These contain from 500,000 to 1,000,000 bricks. A central double wall is built, lengthwise the lower portion, of baked bricks. On both sides longitudinal fire flues of green brick are built. Over them the mass of bricks is laid, with flues leading to the top, and in an open manner, with small scuttles through the heap as it is built up. The top and sides are built of baked bricks. Over all loam is laid to prevent the fire from burning too rapidly. The time required formerly on the Hudson river for burning the great clamps of 1,000,000 bricks was two weeks, and there were required 40 cords of wood for 100,000 bricks. About the year 1838 fine anthracite coal dust was introduced into the clay in the proportion of 75 bushels to 100,000 bricks, and thoroughly mixed in the kneading. The effect of this was to reduce the time to four days, and the wood to 16 cords for 100,000 bricks. Thus 16 cords of wood is rated at $80; 75 bushels of dust, $3; 4 days' attention, $6; total cost, $89, against $212. It follows that, as the heat is very unequal in a clamp, some bricks are underdone, while others are slightly fused on the surface, called "clinker brick."

It is obvious that in brick machinery the saving of labor is the great object, and to attain that a great number of machines have been invented. One of this class forces a lump of clay of the breadth and depth of a brick along a trough; and it is cut off the proper length by a wire. Other machines have been made to stamp the brick out of a lump of clay. Again, the clay is forced into moulds by a heavy roller. There are machines which pulverize the dry clay, and press this with great force into moulds, ready for burning. A patent for this, taken in Baltimore in 1847, and another in Boston, pulverizes, screens, moulds, and presses 2,500 bricks per hour. On this plan bricks are made on Staten Island. They present a smooth surface, but they are not so good as the Philadelphia and Baltimore. Bricks have been made partly hollow to diminish the weight. The size of bricks is $7\frac{3}{4}$ to $8\frac{1}{8}$ inches long, 4 to $4\frac{1}{2}$ wide, and $2\frac{1}{4}$ to $2\frac{1}{2}$ thick. In New York 5 courses of brick are allowed to the foot in height. In New England 5 courses make a foot, without the mortar. The weight of a brick is about 4 lbs., and 21 make a cubic foot of wall. The Philadelphia brick are the best in the country, and are made mostly by hand. The clay and sand give the brick a better color. The Baltimore brick bring a better price because the clay is purer, and therefore stronger, are better burned, and less liable to damage by transportation. The quantity made in Philadelphia is reckoned at 100,000,000 per annum.

The lime used in New York and on the Atlantic coast is mostly of Thomaston, Maine, where it is manufactured of limestone and oyster-shells. Its quality is much superior to that of the lime of other sources. The chief use of lime is for making mortar for cementing brick and stone work and plastering walls. The best qualities, made from pure stones or shells, slake rapidly, and are called fat. This kind more than doubles in bulk on being slaked, and falls into a soft, white paste. The inferior qualities slake slowly, and give out but little heat in the process. The value of lime with masons depends upon the quantity of sand it will bear in the manufacture of strong mortar. Thus the best Thomaston lime will take 8 bbls.



GETTING OUT FLOOR BOARDS BY HAND.
Two hundred feet a day's work. Planer gets out ten thousand feet.




WOODWORTH PLANING MACHINE.

of sand for one of lime. It is stated that an excellent lime is made near New York city from white marble, and that it will take nine barrels of sand. The Thomaston lime is burned with anthracite coal. An excellent lime, equal to the Thomaston, has been produced for a few years past in Alabama, not far from Selma, which is burned either with wood or the bituminous coal which abounds there. New Orleans and the southwestern states are supplied largely from this source.

The building stone of Boston for the best houses has been derived from the immediate neighborhood, and is called Quincy granite. It is a handsome gray stone, hewn for dwellings, but sometimes used unhewn for public buildings. The stone is derived from Quincy, and the first railroad started in the country was for the service of these quarries, having been introduced shortly after their opening. Within a few years past an excellent granite, believed to be more enduring than the Quincy (which crumbled into dust at the great Boston fire), has been found at Mt. Desert Island in Maine. The towers of the East River suspension bridge between New York and Brooklyn are of this granite. The stone for the foundation of the dwelling of Governor Phillips, of Massachusetts, was brought from Rhode Island. Granite quarries are also now worked near New York and in Delaware Bay. These and the Sing Sing marble quarries supply much of the stone for New York city. Most of the fine residences are faced with "brown stone" (red sandstone) from Portland, Conn., or an olive green or rose-tinted sandstone from Nova Scotia and New Brunswick, or of a lighter brown sandstone from Belleville, New Jersey. It by no means follows, however, that a brown stone palace "on an avenue" is built of brown stone. The house is built of lumber and brick, and a thin veneer of brown stone put on the front. The difference in cost between a substantial front of stone and one of Philadelphia brick with stone trimmings will be from $500 to $800. For the construction of large and fashionable stores, the Sing Sing marble is much used, but iron fronts have come into very general use. These are cast in ornamental styles, and put up piece by piece, each being riveted to the other, the whole front thus forming one piece, and then painted to resemble stone. Marble is the favorite material in Philadelphia, notwithstanding her superior brick. It is procured in abundance a few miles from that city.

Stone at the west is not so abundant, but discoveries of good building stone have been made. A yellow stone in the neighborhood of Cincinnati supplies the best material to that city. The canals of Ohio and Illinois carry considerable quantities of Joliet and other limestones, and marble has been found near Dubuque, Iowa. There are quarries of sandstone, marble, and limestone in the neighborhood of Chicago, but since her great fire, in which all these building stones left only little heaps of dust or lime, and the iron structures, believed to be fire-proof, warped, twisted, and fell at the first breath of the devouring flame, there has been a demand for some more enduring material, and granites from Lake Superior and hard, well-burned brick are believed to fulfill the conditions most perfectly.

How long the once mighty forests of the country will supply the prodigious and growing demand for the use of dwellings, is a problem; but long since, the demands of shipwrights have so thinned the Atlantic forests, that it has become cheaper to build upon the lake harbors and western rivers. The scarcity of knees and bends for ship-building led to the invention of the timber-bending machine, by which the straight oak timber was claimed to be bent in curves or at right angles for knees without decreasing its strength. The ports of the west, however, have of late been appealed to, and vessels built at Cleveland and other lake ports, at a small cost for lumber and labor, find their way to sea cheaper than the same class built on the famous old ways of Maine, Massachusetts, or Baltimore. The white oak becomes less abundant, and live oak no greater in supply, while the pine and other woods used in the floors and trimmings, compete with the demand for dwellings. The number of vessels built in 1880, was 1,589, of 92,776.33 tons. If we compare the number and class of vessels built in the western states, not including the Pacific coast, in 1880 with 1829, we shall observe the progress in fifty-one years:—

| | Sailing Vessels. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ships. | Brigs. | Schooners. | Sloops and canal boats. | Steamers. | Total. | Tons. |
| **WEST.** | | | | | | | |
| 1829,............ | .. | 1 | 12 | 4 | 25 | 42 | 9,032 |
| 1880,............ | | 48 | | 42 | 182 | 230 | 55,690.33 |
| **ATLANTIC.** | | | | | | | |
| 1829,............ | 44 | 76 | 473 | 141 | 18 | 743 | 68,066 |
| 1880,............ | | 397 | | 51 | 141 | 1,589 | 92,776.33 |

THE BUILDING TRADES IN 1870.

| Trades. | No of Establishments. | Hands Employed. | Capital Invested. | Wages Paid. | Material Used. | Annual Product. |
|---|---|---|---|---|---|---|
| All these trades,...................... | 56,468 | 381,000 | $306,046,080 | $138,383,056 | $295,595,801 | $597,056,538 |
| Blocks and spars,........................ | 9 | 64 | $66,250 | $31.914 | $28,565 | $95.095 |
| Boats,................................ | 174 | 2,381 | 1,665,193 | 1,225,996 | 1,214,016 | 3.300.775 |
| Brick-making,......................... | 3,114 | 43,293 | 20,504.298 | 10,768,853 | 7,413.097 | 29,028,359 |
| Building stone, artificial,................ | 12 | 67 | 202,100 | 32.570 | 53,945 | 163,400 |
| Carpentering and building,.............. | 17,142 | 67,864 | 25,110,428 | 29,169,588 | 65,943,115 | 132,901,432 |
| Glass, window,......................... | 35 | 2,859 | 3,244,560 | 1,503,277 | 1,400,760 | 3,811.308 |
| Heating apparatus,..................... | 59 | 1,141 | 1.605.830 | 853,516 | 1,424,345 | 3.425.150 |
| Iron castings for stoves, heaters, etc.,... | 326 | 13,325 | 19,833,720 | 8,156.121 | 9,044,069 | 23.380.665 |
| Iron bolts, nuts, washers, and rivets,.... | 93 | 4.423 | 4,263.227 | 1,665,426 | 4,021,070 | 7,191,151 |
| Iron nails and spikes, cut and wrought,.. | 142 | 7.770 | 9,091.912 | 3,961,172 | 18,792.383 | 24,823.996 |
| Iron for ship building and marine engines, | 1 | 352 | 750,000 | 210,000 | 187.000 | 472,000 |
| Lime burners and dealers,............... | 1,001 | 6,450 | 5,344.154 | 1,936.158 | 4,458,542 | 8.917,405 |
| Locksmithing and bell-hanging,......... | 191 | 555 | 229.955 | 160,799 | 170,168 | 608.149 |
| Lumber, planed and sawed,.............. | 26.930 | 163,511 | 161,406,123 | 46,188.893 | 131,830,741 | 252,032.229 |
| Marble and stone work,................ | 923 | 13,190 | 11,287,677 | 7,601,471 | 8,034.858 | 21,316,860 |
| Masonry, brick and stone,............... | 2,264 | 11,043 | 2,546,425 | 4,271,700 | 7,015.782 | 14,587,185 |
| Meters, gas and water,.................. | 15 | 664 | 1.051,000 | 441,940 | 611.663 | 1,452.190 |
| Plastering,............................ | 691 | 2,464 | 353,462 | 900,395 | 907.524 | 2,659,025 |
| Plumbing and gas-fitting,............... | 705 | 4.783 | 3,731,667 | 2,277.644 | 5,167.323 | 10,394,471 |
| Roofing,................................ | 198 | 1,919 | 2,448.680 | 883,341 | 1,293,116 | 3,257,403 |
| Sash, doors, and blinds,................ | 1,605 | 20,379 | 21,239.809 | 10,059,812 | 17,581,814 | 36.625,806 |
| Ship-building, ship materials and repairs, | 762 | 11,063 | 9,102.335 | 5,594.686 | 8,252.394 | 17,910.328 |
| Soap-stone, stoves, fire-place, sinks, etc., | 9 | 74 | 127,500 | 38,444 | 98,325 | 189.115 |
| Vault-lights (of iron and glass),.......... | 2 | 19 | 7,500 | 14,700 | 14.763 | 41.000 |
| Wood brackets, mouldings, and scrolls,.. | 65 | 747 | 832.275 | 434,640 | 636,423 | 1,412,012 |

The annual product of these trades in 1860 was not very completely recorded, but the footings then were $178,539,785; so that the annual product of 1870, $597,056,538, is more than three-fold that of 1860. These statistics are not yet gathered or tabulated for 1880; but when we consider the rapid increase of population and settlement, the great progress made in railroad-building, in mining, and in agriculture, and call to mind the fact that the greater part of the immigration has been to prairie states, where most of the timber and lumber for building purposes must be drawn from distant points, and the immense demand in our large cities for the more costly building materials, I think we shall be justified in predicting that the table of the building trades for 1880, when it shall be completed, will indicate an annual production in them all considerably exceeding twelve hundred million dollars.

## CARRIAGES AND COACHES.

The improvements in the means of transportation in the United States are very manifest in the number and quality of private carriages of all kinds that are now kept by almost all who live out of cities, and by very many of those who reside in them. With the multiplication of railroads, which were to supply the place of stage-coaches, it was supposed that the number of horses employed would be greatly diminished. The contrary seems, however, to be the fact, since the greater breadth of land by their means laid open to market, and the resulting general wealth, have enabled all to keep pleasure-vehicles, when formerly the saddle only was used outside the stage-coach. The plain, springless box-wagon of the farmer conveyed his family to and from church on Sunday, and hauled his produce on week-days, until within a half-century, when the idea of extravagance attached to the possession of pleasure or spring-wagons began to give way, and those vehicles were found in the carriage-house, before the piano supplanted the quilting-frame in the parlor. The style adopted in 1830 was the omnibus or long coach. One vehicle was then started to run up Broadway for $12\frac{1}{2}$ cents per head. The success was complete, and the number multiplied, while the fare fell successively, until for several years the most successful charged five cents in common with the horse-cars. In 1864 they raised their fares to ten cents, but reduced it again in 1876, the competition of the horse-cars having reduced their number of passengers. There are not more than 120 omnibuses now running in New York and hardly a dozen in Brooklyn. At one time there were 440 plying the streets in New York. They are strongly and well built, and well upholstered, but their day of attractiveness is past.

The horse-cars commenced running as early as 1841, when the Harlem Railroad began to run small cars drawn by horses from Canal street to 42d street, where the passengers changed into the larger steam cars. It does not seem to have occurred to anybody for some years that lines of horse-cars could be run which were not connected with some line of steam roads. At first, too, there was a strong objection to the rails of the Harlem Road, which were the ordinary T or H rail; it was said that in crossing these tracks diagonally carriages and wagons were violently wrenched and often broken. When street railroads began to multiply (about 1850) many experiments were made upon rails, and finally the present pattern—a broad grooved rail, even with the pavement of the street—was finally adopted. The first street-cars were rather comfortless affairs, but improvements were soon made, and now most of them are very pleasant. They are generally well lighted, and some lines heat them in winter. The closed car drawn by two horses has seats for 22 or 24 persons, and at times nearly twice that number stand in the car, but their position is very uncomfortable. The "bobtail," or one-horse cars, have a driver but no conductor, and the passengers are required to put their fares in a box near the driver, and under his control. The "bobtail" has seats for 12 or 14, and by close packing about as many more can find standing room. The open cars will seat 50 or 60, and a few can stand at the ends. These are called horse-cars, though some of them are drawn by steam or other "motors." The Coney Island and Rockaway railroads run cars very similar to the open cars, and these are drawn by steam locomotives. In the height of the season, as many as 100,000 passengers are conveyed over these roads each way in a day. Horse or motor railroads are now used on many streets of all our large and many of the smaller cities throughout the country. They have extended to San Francisco and Denver at the west, to Memphis, New Orleans, and Mobile at the south, to all the Atlantic cities and large towns at the east, and to the principal cities and large towns of New England, New York, and Canada. At least 300 million dollars of capital are invested in them. They are generally, and perhaps always, of three-foot gauge. But neither omnibus nor horse-car is quite fast enough for this fast age, and the elevated railway, or the "L," as it is "called for short," seems to be the coming means of locomotion in our great cities. The underground road is endeavoring to compete with it, but will fail, since people in general dislike tunnels. New York has taken the lead in these, but other cities are already following her example. The actual cost of construction is heavy, but the nominal price has been greatly increased by speculation and watering the stock. As the right of way through or rather over the streets is granted by legislatures or city councils, probably from $100,000 to $150,000 per mile ought to build and equip the road, but one at least of the New York roads has issued stocks and bonds to the amount of a million dollars per mile.

The building of railways all over the country (about 50,000 miles within the last ten years) has enormously increased the demand for and the production of railroad passenger, freight, coal, and oil cars. The ordinary passenger cars have not greatly improved in quality during the decade, but the practice of running palace cars on all the fast through trains has made a remarkable change in the methods and comfort of travel on long routes. The first inventor, or at least the first manufacturer of these cars on a large scale was Mr. George Pullman, now, we believe, of Chicago; there are now some half dozen or more manufacturers. They are of various kinds: "sleepers," or sleeping cars, which are fitted up with comfortable berths and all the appliances of a guest chamber, and are so arranged as to be capable of transformation in the day time into pleasant drawing-rooms; the passenger or passengers can take each a single berth, or if they prefer, a half or whole section by paying the proportionate prices; drawing-room cars proper, generally on day routes, having no beds or common cushioned seats, but only easy chairs, sofas, etc., elegant mirrors, rich carpets, etc.; and dining-room or hotel cars, with kitchen and dining-room well furnished and which supply meals at regular hours to passengers, without the delay and inconveniences of the dining-rooms at the stations. All these cars have an extra number of trucks, and the best steel and rubber springs, so as to make the travel nearly noiseless, and almost wholly without jolting or unpleasant motion. The cars are substantially and elegantly constructed, with plate glass windows, fine panelings, mirrors, and rich and tasteful upholstery. Their freedom from jolting is best demonstrated by the fact that it was said of the car on which President Garfield was carried to Long Branch, which was run on the palace car trucks, that as he lay on his back, a full goblet of water might have been placed on his breast, and in the whole journey of nearly 250 miles, not a drop would have been spilled, although the speed at times exceeded sixty miles an hour. The palace cars are indeed the perfection of railroad travel, but the expense of travel on them, in addition to the ordinary railroad fares, is considerable, averaging about a cent a mile to each passenger. In most cases they are not owned by the railway companies, but are run on the routes with the other passenger cars and a royalty is paid to the owners for each passenger. Some of the railways, however, and among the number the New York Central, Pennsylvania Central, and perhaps the Baltimore and Ohio with their western connections, run their own palace cars. Some of these roads make up limited express trains composed wholly of palace cars.

The multiplication of narrow-gauge (three-foot) roads at the west and on short routes to seaside resorts at the east, has necessitated the construction of a different style of cars for passengers from those on the roads of ordinary gauge. Of course the car is always considerably wider than the track, but a car to run on a narrow-gauge is very much narrower and lighter than one to run on the regulation 4 feet, 8½-inch gauge. They are well built, strong, and comfortable, but there is not, in general, so much expense for mere ornamental decoration as in the larger cars.

It will have been remarked by the observing reader that in every branch of industry which has been recently taken hold of by the American manufacturer, facility of production and cheapness of sale-prices have, hand in hand, made rapid progress. This remarkable feature has been due mostly to one principle: it is that of reducing the manufacture to its utmost subdivision, and making a distinct branch of each separate part of the object to be completed. A pattern being once fixed upon, all the parts of that pattern are given out to workmen, who confine themselves each to the manufacturing of the part he undertakes. The parts so produced are made in the best manner. In this minute subdivision of labor there is a constant tendency to resort to machinery, because that where there is a great demand to be supplied the various parts can be produced much more rapidly and in many cases more perfectly by machinery than by manual labor. This is not the case, however, with the best descriptions of pleasure carriages. Two entirely diverse theories have formed the basis of action among the carriage-building fraternity, and, as might be expected, have produced entirely diverse results. One theory seeks to cheapen production, and by the liberal use of machinery and the concealment afforded by paint, varnish, and upholstery, makes its thousands of carriages of showy appearance to sell. These carriages are often of tasteful patterns, and to the inexperienced purchaser look as well as others for which twice or three times the price is demanded. Running on the better class of country roads, and not on the hard and often rough pavements of the cities, they will not unfrequently do good service for a long time. It is undoubtedly true that really good and snbstantial carriages can be made by the aid of machinery. Some of the New Haven manufacturers make good and serviceable carriages, which will endure city wear.

A very low-price carriage is, however, especially for use upon the pavements, the dearest carriage a purchaser can buy. It will give out, first at one point, then at another, and after having had repairs enough to have paid for a new vehicle, it is a rickety old carriage after all. There is, nevertheless, a large demand for cheap carriages, and it is supplied from Belchertown, Mass., Newark, N. J., New Haven, Conn., Philadelphia, Dayton, Ohio, Chicago, St. Louis, Jacksonville, Ill., and other places east and west. In most of these places the manufacturers make a grade of good carriages, for which they find a market at home.

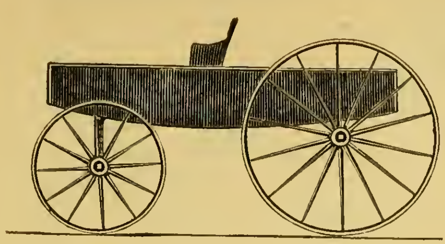
The other theory of carriage-building does not seek to acquire a reputation for cheapness. It ignores the use of machinery, preferring thorough, faithful hand labor to it, and by careful selection of all its material, thorough seasoning, honest and patient work by skillful workmen, and a critical examination of the carriage in every stage of its progress, rejecting at once all flaws or imperfect work, endeavors to make a perfect and enduring vehicle, which will last twenty-five years, and when it finally fails, will give way "all at once, and nothing first." Of course the prices of these carriages are high, and the customers for them are principally the wealthy and dwellers in cities, who find them admirably adapted for use upon the pavements ; but this class and the keepers of livery stables, who find the best carriages they can procure the cheapest in the end, create a sufficient demand for them to keep large manufactories constantly employed. The "Brewster carriages," made in Broome street, New York, have at present a very high reputation among carriages made on this theory, but there are other manufacturers, both in New York and our other large cities, who doubtless do as good work.

It is such enterprise and success as this that drew from the London jurors of the World's Fair, the following remarks in their report : "Comparing the state of the art of carriage-building," say the London jurors, in their report on carriages exhibited at the World's Fair, "of former and not very distant times, with that of the present, we consider the principles of building in many respects greatly improved, and particularly with reference to the lightness, and a due regard to strength, which are evident in carriages of British make ; and especially displayed in those contributed by the United States, where there is commonly employed in the construction of wheels, and other parts requiring strength and lightness combined, a native wood (upland hickory) which is admirably adapted to the purpose. The carriages from the continental states do not exhibit this useful feature in an equal degree."

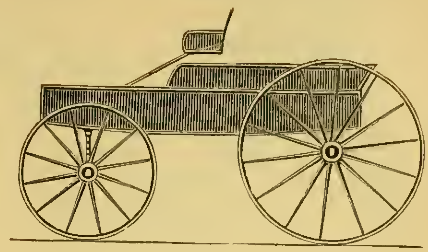
The woods most used in the construction of carriages, ash, oak, and hickory, grow of superior quality and in great abundance in the neighborhood of Philadelphia, and the fact gives the art of carriage-making there great advantages. There are in that city over fifty factories that produce pleasure-carriages. The capital invested is over $600,000, and over 1,000 hands are employed. The vehicles are mostly for city use, with some export demand. One of the largest factories of the city, Roger & Co., occupies 40,000 feet of work room, and employs 125 men in all the departments of designers, body-makers, wheelwrights, carvers, painters, platers, trimmers, upholsterers, etc. The wagons of that establishment have a good reputation. In New York, the carriage business is pushed to a great extent. The demand for heavy vehicles for the great cities is large, and the effect of railroads, in spreading the population of the city over a radius of 40 miles around it, has caused a considerable demand for pleasure-wagons and carriages. Some persons who would have no use for a vehicle in the city, in adopting a suburban home, have found at once that a carriage was a necessity.

The number of cars made per annum in the state of New York in 1870, was 1,349, and there were used 7,554,709 feet of lumber in their construction, and in that of wagons, 2,703,975 feet. There were 915,780 spokes made. The number of wagons turned out was 6,391, and of sleighs 605. The census of 1880, when complete, will indicate a great increase in the last decade. The city of Brooklyn, which has put forward no claim to a prominence in the carriage manufacture, reported, in 1880, 105 factories, employing nearly 1,000 men, and producing $1,008,719 worth of carriages and wagons. The size of some of these factories, and the number of vehicles turned out, are surprising. The numerous depots for carriages in the city contain every possible description of vehicles, and of all manufactures. The carriage manufacture in New Jersey stands next in magnitude to that of New York. This is mostly at Newark, where great numbers are turned out, of an approved quality. A feature of the carriage and wagon business that has been introduced of late years, is that all possible parts of vehicles can be purchased in any quantity, consequently the wheelwright business of small towns has been entirely revolutionized. They can no longer make an entire vehicle, as formerly, with any success, but purchase wheels, axles, top frames, springs, etc., of any and every pattern, to put together and finish. All these parts are produced in great quantities, by machine. Hence, as we see, there are a very large number of spoke factories which turn out millions of spokes per annum. The largest city factories, however, make all the parts within themselves. Let us trace the successive steps of the building of a pleasure-carriage. The design, whatever may be the style, is first prepared on paper ¾ of an inch to the foot. This being approved by the purchaser or owner, a geometrical plan is executed upon the black-board. The patterns are then cut in the wood, and from this skeleton the shape and proportions are determined. There must be exercised in this process the utmost mathematical exactness, and the most careful selection of material. The wooden frame is now removed to the smithy; then come in requisition, springs, tires, hinges, axles, bolts, locks, and every variety of form by which iron can conduce to the strength of the fabric. This being completed, the skeleton is moved to the body department, to receive its floors and panels, the sides with their proper curvature, the seats of the destined construction, and the doors with their trimmings. From this room the body goes to the paint room. Formerly this was a tedious process, but the adoption of Wheeler's (of the Wheeler & Wilson S. M. Co.) patent wood filling so completely fills and polishes the surface of the wood as to render only a single coat of paint necessary before the color painting and the repeated varnishings and rubbings down required. The carriage next seeks the trimming room, to be decked with fine cloths, silks, lace, carpet, embossed leather, or the finest morocco, and becomes as tasteful as art can make it. While the body of the vehicle is thus being prepared, the carriage, or wheels, axles, perches and shafts have also been approaching a state ready to receive it. The felloes, shafts, and nave, each of its appropriate and well-selected wood, are combined into wheels, that must in size bear a certain proportion to the body. The average difference between the fore and hind wheels is eight inches. In the combination, each department supplies its proper part, and when ready to receive the body, that is hung upon the springs, and the whole is ready for the final polish. Apart from the coach or pleasure-vehicle business, is the wagon business, which is of great extent, all the parts being formed by machines of late invention. The lumber for these heavy vehicles is of considerable dimensions. The plank used is three to four inches thick. This must be all well seasoned. Hence capital is required to keep a sufficient stock on hand, since it requires four or five years to season, or one year for every inch of thickness. The timber for hubs is of black locust. This, of different sizes, has the bark removed, and is bored through the centre to facilitate the seasoning. All the lumber thus seasoned in stock, is, when ready, removed to the saw-mill. Here machines are usually ready to shape every part: upright and circular saws to cut the plank into shafts and felloes after it is marked; planing machines, and mortising machinery; lathes for turning spokes and hubs; for boring holes for the spokes; for driving in the spokes; for shaping and finishing the felloes; for boring holes in the hubs to receive the boxes, so as to insure a solid bearing, and for turning the hubs, of which the two ends are cut off at once by circular saws. All these machines soon turn the solid plank into finished wheels, while the body is growing under similar applications in another room, under the direction of various departments. The iron axles are turned in the machine shops, where also all the tires, bands, straps, bolts, rivets, etc., are prepared and applied. The wagons are then ready for the paint. This is the general operation of wagon-making in large establishments. During the war, some hundreds of thousands of army wagons were required by the government, and the energies of the manufacturers were severely taxed to furnish them as fast as they were needed. Numerous ambulances were also built for the army.

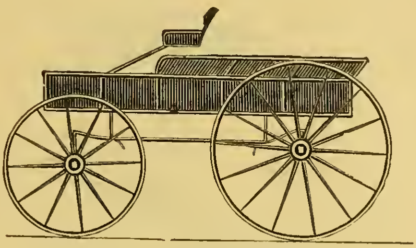
The demand for express wagons that has grown up of late years, has become very large, and they are produced in great per-



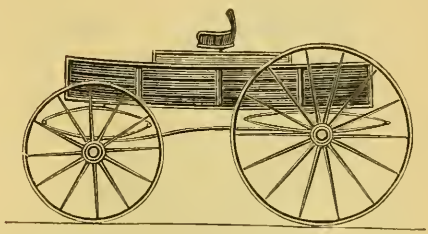
1810.



1820.

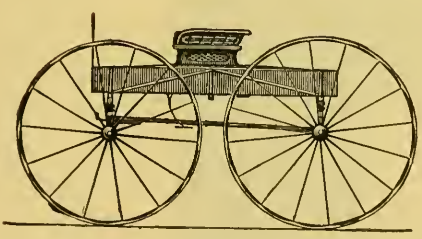


THOROUGH BRACE—1825.

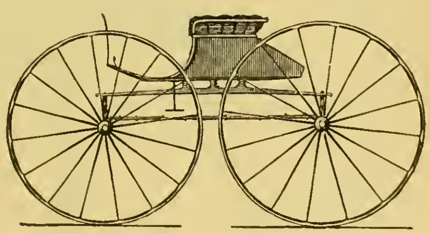


FIRST ELLIPTIC SPRINGS.

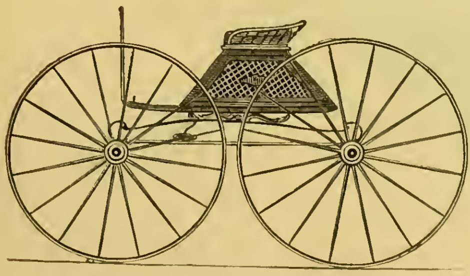
The following are a few of the many styles from 1830 to 1850.



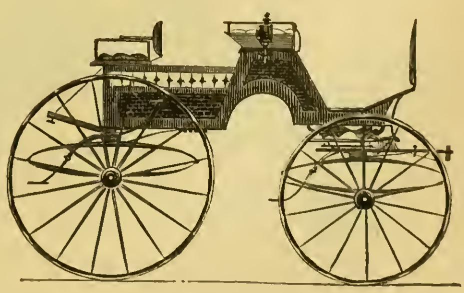
JAGGER.



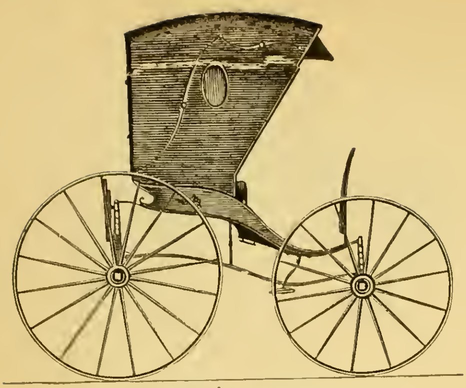
GAZELLE.



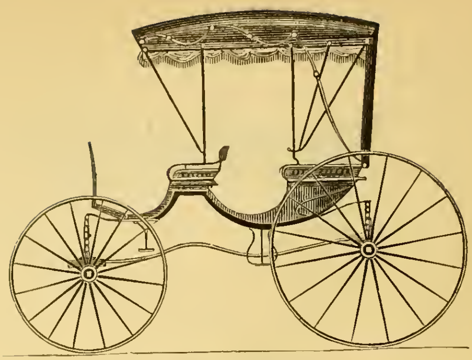
CRICKET.



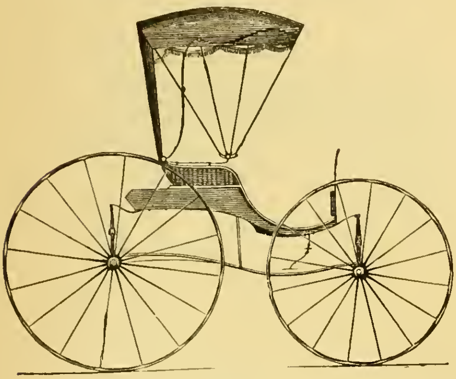
FRENCH DOG CART.



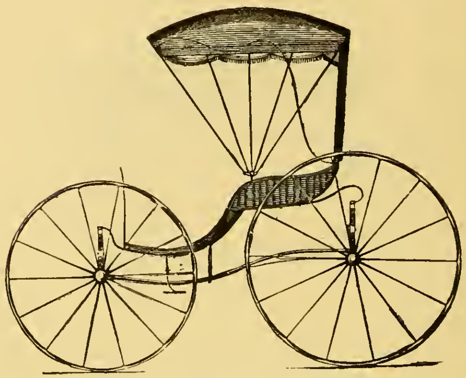
DOCTOR'S PHAETON.



FULL TOP CABRIOLET.

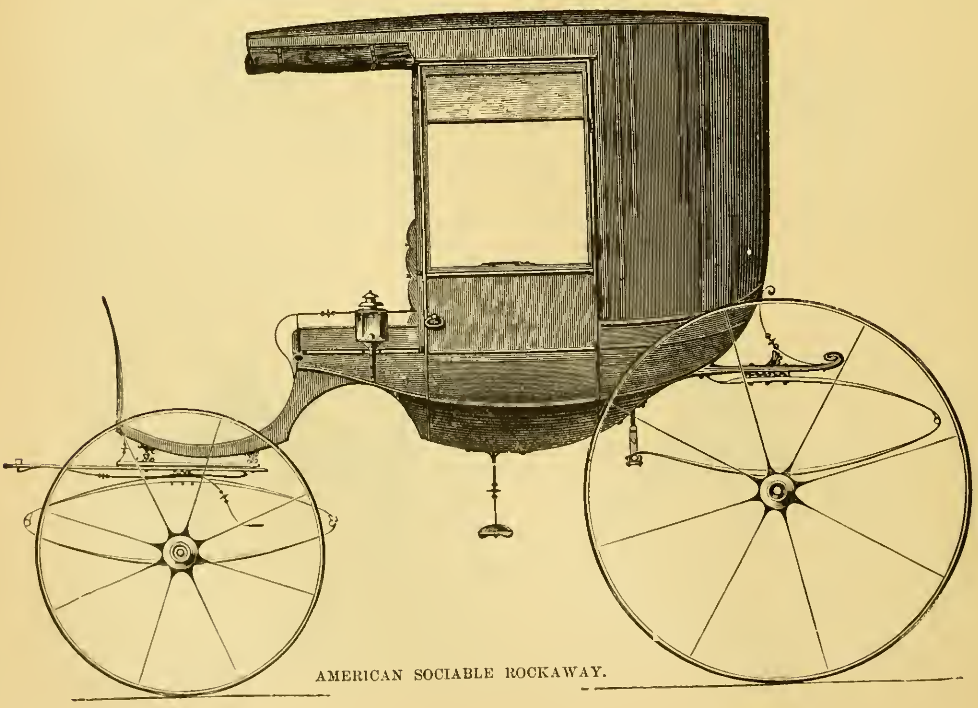


CHAMPION.

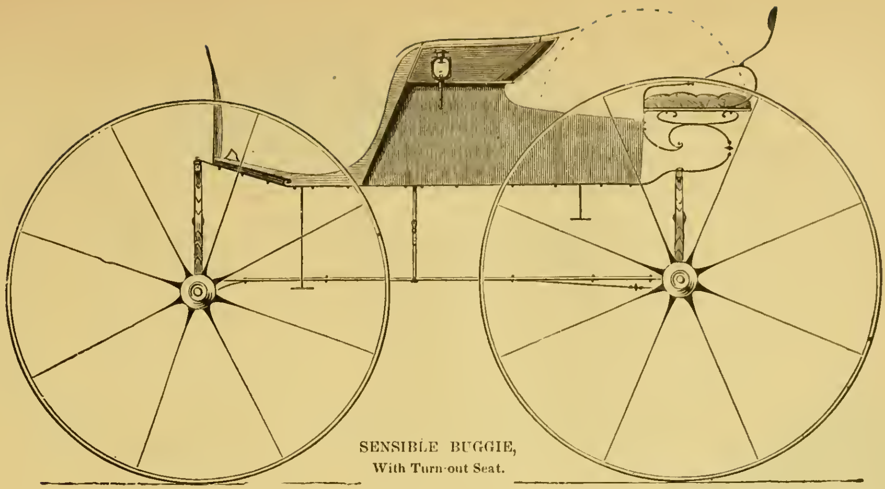


PRINCE OF WALES.

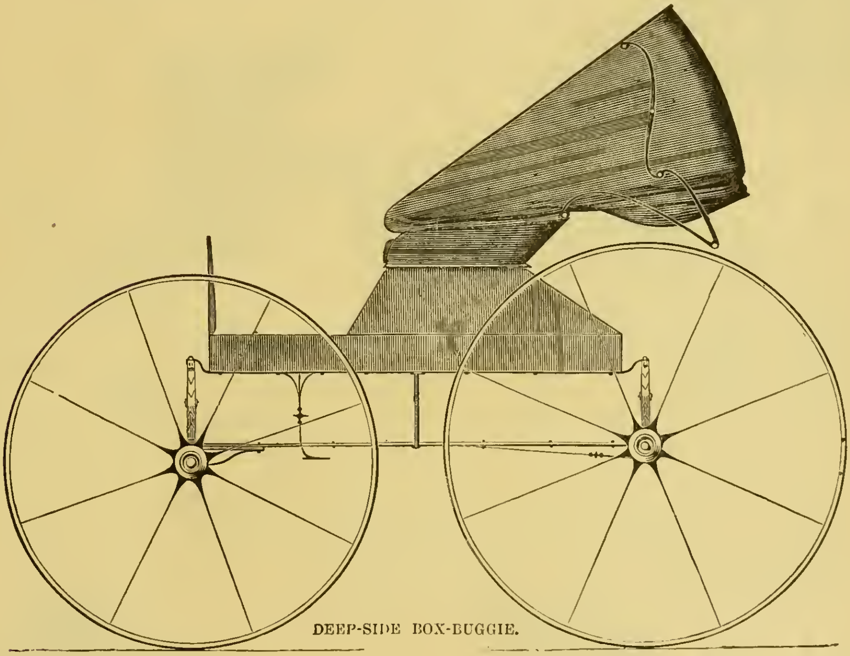
The following are a few of the many styles from 1850 to 1870.



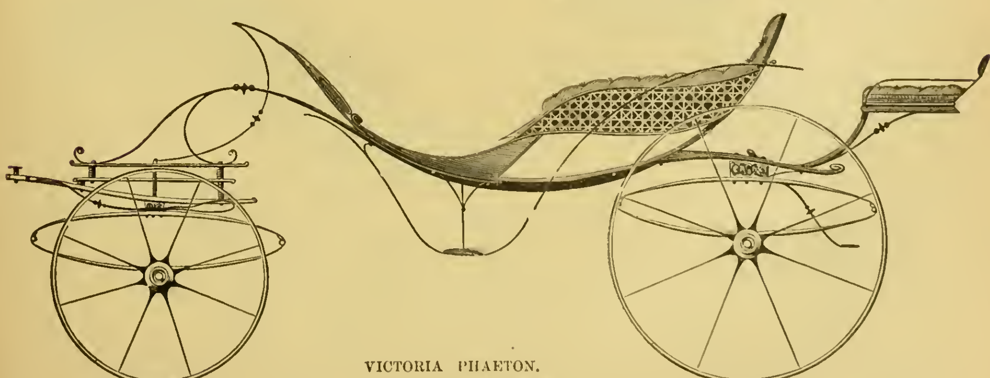
AMERICAN SOCIABLE ROCKAWAY.



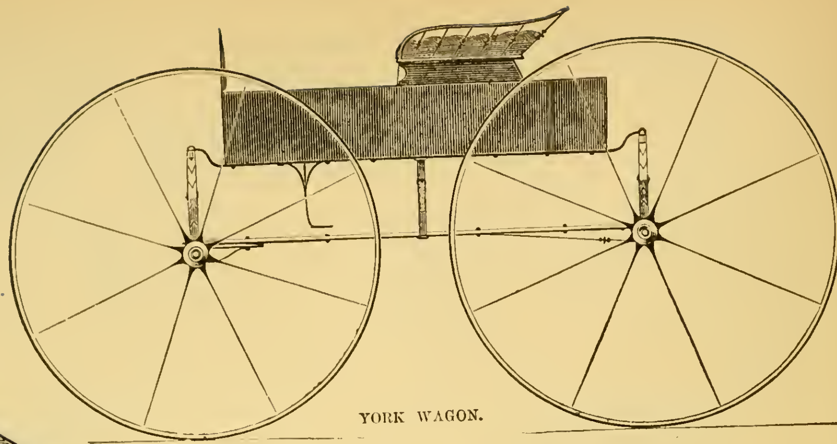
SENSIBLE BUGGIE,
With Turn-out Seat.



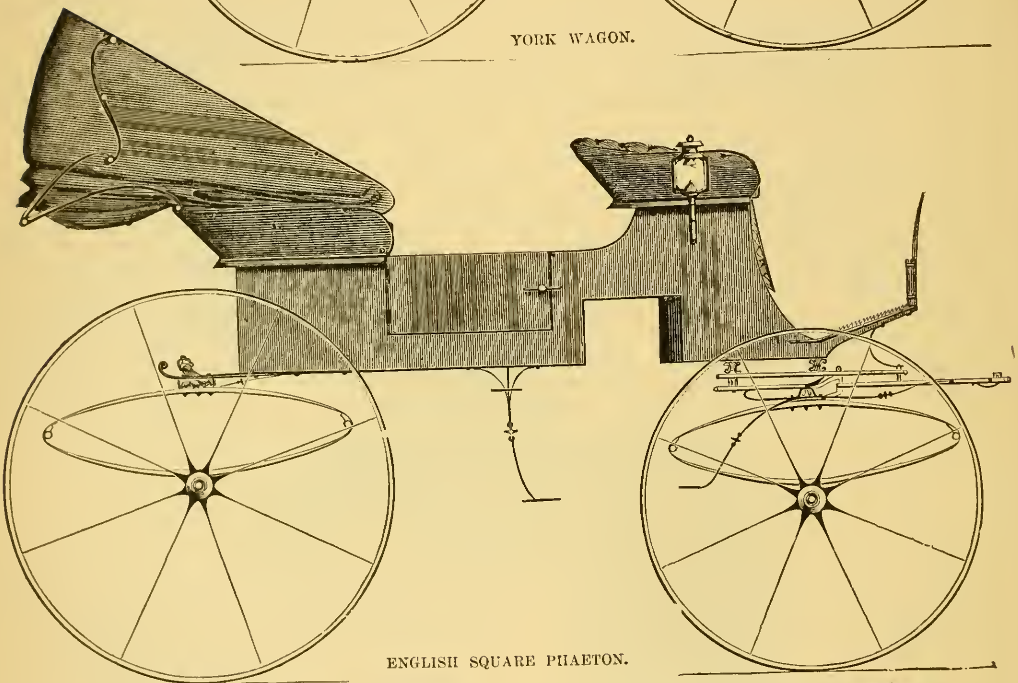
DEEP-SIDE BOX-BUGGIE.



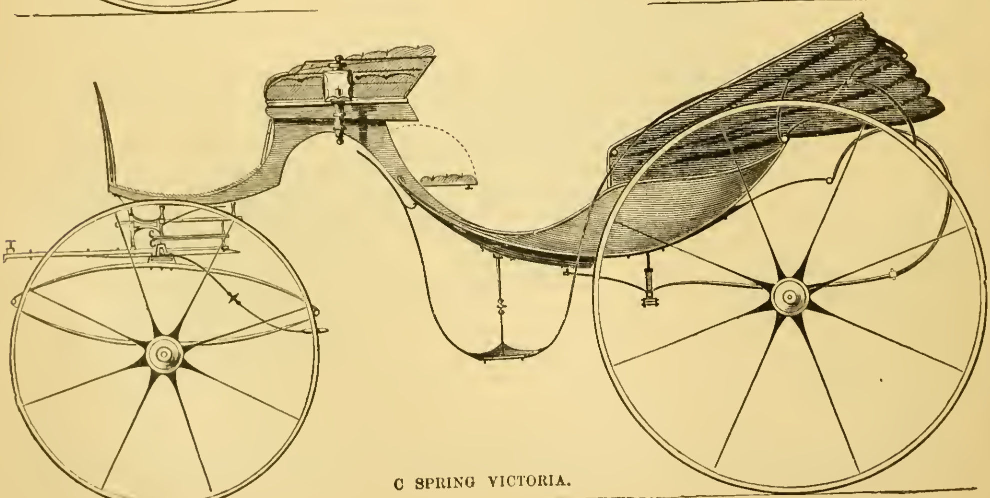
VICTORIA PHAETON.



YORK WAGON.



ENGLISH SQUARE PHAETON.



C SPRING VICTORIA.

fection as respects strength and price. Another large demand for vehicles has taken the shape of railroad cars, and these more than rival coaches in the extent of manufacture. In New York, the value of production is nearly $6,500,000 per annum. Most car wheels are of iron, and the utmost care is taken in the manufacture of them, that when cast the iron shall cool equally in all its parts. For this purpose, when the wheel is cast in a mold, it is removed as speedily as possible into a circular chamber or furnace, composed of fire brick, 4½ inches thick, and surrounded by an iron case. When they are there deposited, the opening is closed, and the heat of the whole is raised to nearly the melting point. All the avenues to and from the interior are then closed, and the whole is left to cool gradually. By this process of raising the heat, the temperature of the wheel is equalized in all its parts, and as the heat can then only subside through the wall, it cools so gradually that all parts of the wheel contract alike. For this cooling four days are required. While red-hot the wheel is removed, and having its edges packed round with sand, the center is made to communicate, by means of a flue, with a chimney 120 feet high. The draught thus created cools the center. The same, if not far greater importance attaches to the uniform toughness of the iron of a wheel as to that of a cannon. The lives of hundreds of passengers are always depending upon the soundness of the running wheels, and the utmost care is taken to make and keep them sound. Of late years paper or papier-maché has been used to a considerable extent for car-wheels; it is subjected to an immense pressure, and an iron or steel tire shrunk on. It is claimed that these paper wheels are more enduring, and make less noise than any other wheels yet invented.

THE PROGRESS OF THE CARRIAGE MANUFACTURE IN THE LAST FORTY YEARS—1840-1880.

| Census Year. | No. of Establishments. | Persons Employed. | Wages Paid. | Value of Raw Material. | Carriages, wagons, coaches, children's and dolls' carriages produced. | Value of Annual Product. |
|---|---|---|---|---|---|---|
| 1840 | 92 | 2,274 | ......... | ......... | 13,331 | 1,708.741 |
| 1850 | 1.822 | 14,000 | ......... | ......... | 95,000 | 12.000,000 |
| 1860 | 7.234 | 37,457 | $13,547,356 | $12,008.675 | 270,000 | 35.927,192 |
| 1870 | 11.944 | 56.294 | 21,749.625 | 23,385,683 | 800.000 | 67.003.730 |
| 1880* | 18,350 | 102,500 | 39,625,000 | 47,250,000 | 1,350,000 | 123.500,000 |

*Estimated.

WE ADD THE CENSUS STATISTICS OF 1870 AND 1880 OF THE ENTIRE TRADES WHICH ARE CONCERNED IN THE CARRIAGE AND CAR MANUFACTURE.

| | No. of Establishments | Persons Employed. | Wages Paid. | Value of Raw Material. | Value of Annual Product. |
|---|---|---|---|---|---|
| 1870. | | | | | |
| Carriage trimmings, | 44 | 453 | $144.278 | $214,544 | $590.878 |
| Carriages and sleds, children's, | 53 | 913 | 407,327 | 495,281 | 1.432.833 |
| Carriages and wagons, | 11,847 | 54,928 | 21,272.730 | 22,787.341 | 65,362,837 |
| Car fixtures and trimmings, | 3 | 122 | 69.568 | 73.061 | 208.080 |
| Cars. railroad, and repairs of, | 170 | 15.931 | 9,659.992 | 18.117.707 | 31,070.734 |
| Hubs, spokes, shafts, wheels, and felloes, | 302 | 3,721 | 1,544,896 | 2.204,713 | 5,285.157 |
| Totals, | 12,419 | 76,068 | $33,098,791 | $43,892,647 | $103,950,519 |
| 1880. | | | | | |
| Carriage trimmings, | | | | | |
| Carriages and sleds, children's, | | | | | |
| Carriages and wagons, | | | | | |
| Car fixtures and trimmings, | | | | | |
| Cars, railroad, and repairs of, | | | | | |
| Hubs, spokes, shafts, wheels, and felloes, | | | | | |
| Totals, | | | | | |

## AMERICAN CLOCKS.

Perhaps there is no one article of more general utility than "Yankee clocks," and none on which more small wit has been expended both at home and abroad. The land of "wooden clocks and nutmegs" has been a standing jibe against those who have so cleverly and perseveringly executed those practical ideas that tend directly to the amelioration of the human condition. Alfred the Great and other old progress men discovered the value of time, and were hard put to it to measure it out. Some of the old fellows sought to do it by the dropping of water; and many marked the progress of the sun; and other devices were employed without very great accuracy. Alfred contrived twelve candles. which being burned one after the other, divided his day into twelve portions, which had each their special employment. Twelve candles were not convenient, however, to carry in one's fob, and were troublesome to light and snuff. If a Yankee peddler had walked in upon him with a wooden clock under his arm to sell for a crown piece, he would have been in far more danger of being burned for a wizard than of being laughed at as a humbug. The water-clock, in which the wheels were turned by the flow of water, was for two thousand years the only clock of the world. In the eleventh century, falling weights were substituted for flowing water, but the clocks were huge affairs, only used in churches and monasteries. The escapement wheel was invented in 1379 by Henry de Vick. About two hundred years later, Galileo discovered the law of the pendulum, and the mechanism of the clock underwent no further material change for another century. They were a luxury attainable only by the rich. They were imported into this country from Europe down to the formation of the federal government, at high prices. Some of these were the pendulum clocks, about six feet high, and generally stood in the landings of the old houses. About the time of the formation of the federal government, however, Eli Terry, of Windsor, Connecticut, made some clocks of wood, of a small size, to hang up against the wall. In 1793, he began making them as a business, in Plymouth, Connecticut. Then he made a few in the year by his own labor. In 1800, he had procured the help of two young men. The wheels were marked out on the wood with square and compass, and then cut out with a fine saw and jack-knife, the teeth of the wheels being formed in the same manner. Twice a year Mr. Terry would pack up some of these clocks and make a journey into the new country west of the North River. His success in this led to the formation of a company in Waterbury, in 1807, to furnish him with material for his work. Purchasing an old mill, he introduced some machinery, and undertook to make 500 clocks at one time, a larger number than any clock-maker in the world had ever attempted. The price of these clocks under such extravagant production fell from $25, which, though often paid in barter, had hitherto been the regular price, to $20, $15, and finally, in 1811 or 1812, to $10. In 1810, Mr. Terry sold his factory to Messrs. Seth Thomas and Silas Hoadley, but a short time after he went into the business again. Messrs. Thomas and Hoadley carried on the business together till 1813, when Mr. Thomas bought out his partner, and established himself in business in Thomaston, then a part of Plymouth, and since that time it has been conducted there without failure or intermission. It has been incorporated since 1853 as the Seth Thomas Clock Co., and in its various departments of common one and eight-day clocks, levers, one and eight-day, with and without strike and alarm, office, hanging, and calendar clocks, clock movements. elegant mantel clocks, and tower clocks, it is the largest clock manufactory in the world. But to return to our history. Mr. Terry having resumed business, and finding the trade greatly depressed, clocks selling at $5, and some of the new firms failing, invented a new style which he called the "Pillar Scroll Top Case," and which sold largely through peddlers at $15. Among his apprentices was Chauncey Jerome, who after coming of age commenced business for himself, and after many vicissitudes became the largest manufacturer of cheap clocks in the world. His principal factory was at New Haven, and his frequent introduction of new styles revived the flagging trade. In 1837, however, the great financial panic ruined most of the clock manufacturers, and greatly reduced the business of those who stood the shock. Up to this time clocks had been made wholly of wood, the movements being of maple, oak, and cherry, the pinions of ivy or laurel, and the dials of whitewood. In 1837, a thirty-hour clock with brass movement was invented, but owing to the financial depression was not manufactured to any extent before 1840 or 1841. Eight-day clocks with brass movement followed, and very soon the business was greatly increased, and brass rolling-mills erected to supply the metal for the plates and wheels. Every part of the manufacture was cheapened till one style of the thirty-hour clocks was sold as low as 75 cents, and a very fair eight-day clock for $4. American clocks are sold in immense quantities in all the countries of Europe, Western Asia, China, Japan, South America, and South Africa. The house of Jerome & Co. was merged into a joint stock company in 1850, called the Jerome Manufacturing Co. In 1853 and 1854, this company produced 444,000 clocks per annum, and other companies as many more. Of the thirty one clock companies in operation in 1852, nine failed, four were burned out, and five wound up on account of low prices. In 1855, both the Jerome Company and J. C. Brown, the next largest manufacturer, failed.

A reorganization of the business followed, and now (1882) the manufacture of clocks in this country is practically in the hands of a few firms. Of these the following are the only considerable ones: The Seth Thomas Clock Co., of Thomaston, Conn., the oldest house now in the business, manufacturing over 400,000 clocks annually, and making sales to the amount of over a million dollars; this company have absorbed the Seth Thomas Sons & Co., and some other manufacturers; The New Haven Clock Co., of New Haven, Conn., successors to the Jerome Manufacturing Co.; the Ansonia Clock Co., successors to J. C. Brown & Co., who have now a very large factory in Brooklyn, N.Y.; the E. N. Welch Manufacturing Co., of Forestville, Conn.; the Waterbury Clock Co., of Waterbury, Conn., successors to Benedict, Burnham & Co.: The William L. Gilbert Manufacturing Co., of Winsted, Conn.; E. Ingraham & Co., Welch, Spring & Co., the Barnes Clock Co., formerly the Atkins Clock Co., all of Bristol, Conn., or its vicinity; The Scoville Manufacturing Co., of Waterbury, who have absorbed Samuel Peck & Co., formerly of New Haven; and the Terry Clock Co., formerly of Waterbury, but now of Pittsfield, Mass. The only manufacturers of tower clocks are the Seth Thomas Clock Co., whose Hotchkiss tower clocks have the highest reputation, the Howard Watch and Clock Co., of Boston, and Mr. Charles Fasold, of Albany, who has, however, made very few. Regulators of the very best quality are now made by the Howard Watch & Clock Co., the Seth Thomas Clock Co., the William L. Gilbert Clock Co., of Winsted, the Waterbury Clock Co., and Welch, Spring & Co., of Bristol. The finest French parlor or mantel clocks, fully equal to the imported, are made by the Seth Thomas Clock Co. The Terry Clock Co., of Pittsfield, and, we believe, also the Ansonia Clock Co., of Brooklyn, make neat parlor clocks. Calendar clocks are made by most of the manufacturers. The greatest success of the last decade, in the clock line, has been the little lever clock, either one-day or eight-day, and with or without strike or alarm. Lever clocks have been known abroad for one hundred years and more, and in this country for fifty years, but had not been very popular, till Mr. Seth E. Thomas, of the Seth Thomas Clock Co., invented his "Nutmeg Lever," in 1874, and that company followed it with other patterns subsequently, and have manufactured from 600 to 1,200 of them a day since that time. Most of the other companies are now manufacturing lever clocks of all descriptions, and probably nearly 500,000 are made annually. They are sold at very low prices, and are very convenient for household and office use. The one-day levers are better than the eight-day, as the latter do not keep as accurate time. The Seth Thomas Clock Co. have also recently introduced another novelty, viz., clocks with a wood case of the best cherry, ebonized, or in some instances of marble, and of graceful architectural patterns, with what are known as cathedral bells; the bell being a highly-tempered spiral coil of steel wire, supported by a strong upright pillar of small dimensions, whose foot is fixed to a thin elastic board at the bottom of the case. The tones of the bell are sweet and musical. The movement is the same with the mantel clocks. There are annually produced in this country about two and a half million clocks, and their value is between five and six million dollars.

## AMERICAN WATCHES.

In our chapter on Clocks we have given a condensed history of the slow processes, by which the civilized world attained to an accurate measurement of time. The clock was the mother of the watch. The means of producing regulated motion were substantially the same, for Vick's escapement which, though not the first, was the best, had been invented before 1379, and in the early part of the next century it had been discovered that clock-work could be set in motion as well by the gradual uncoiling of a spring as by the running down of weights, and that those motions could be made in equal time either by the swing of a pendulum attached to an escapement like Vick's, or by a balance wheel acting upon the escapement. Yet the "pocket clock," or "Nuremberg animated egg," was not invented till 1477, when Peter Helé, a clockmaker of that city, after a year's labor, produced what at the time was considered one of the wonders of the world. Its price and the price of its duplicates, comparing the purchasing power of money at that time and now, was a sum equal to $1,500 of our money. Yet, judging by our present standards, it does not seem to have been very valuable as a watch; it had no hairspring (for *that* was not invented till almost 200 years later), but it did have a *fusee*, and the precursor of the fusee chain, made of catgut; it was egg-shaped, and about the size of a goose-egg; it required winding up twice a day, and its usual daily variation from correct time was nearly an hour. From this to an American watch of our own time, which without special adjustment will not vary more than two minutes in a month, and which can be regulated to the fifth of a second, is quite an advance. One hundred and twenty-five years later the catgut fusee had been exchanged for the metallic fusee chain with its hundreds of minute and highly-finished steel links, a great improvement, but liable to break or become unfastened. The next great invention was that of the hairspring or balance-spring, and its application to the balance, and the discovery that within certain limits its vibrations were made in equal time. Both Huyghens and Dr. Robert Hooke claim this invention and discovery, and both probably made it, but Hooke's claim is prior to Huyghens' by fifteen or sixteen years, having been made in 1658 or 1659, while Huyghens' earliest date is 1674. For the next hundred years the watchmakers wearied themselves in the attempt to invent some new escapements; the "patent lever, or detached lever," "detached escapement," and "anchor escapement" vary more in form and efficiency of action than in principle. About 1700, the use of jewels—ruby, sapphire, chrysolite, garnet, or aqua-marine—for the bearings of pivots, was introduced. The compensating balance was invented by J. Harrison, in 1767, to equalize any influence exerted by variations of temperature to which the two metals of which it was composed might be subjected. The circumference of the compensating balance is divided into two sections, the opposite ends of which are fastened to the cross bar of steel; the outer rim of the balance is brass; the inner rim, which is soldered to it, of steel, and each half of the circle has one end free, while the different contractility or expansibility of the two metals compensate each other.

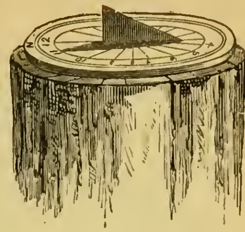
With these improvements the English watch attained its highest development. It was thick and clumsy, though less so of later years than formerly; when well made it was a fair time-keeper, seldom varying more than two or three minutes in a week, but it was necessarily high priced, for its different parts were made by hand in places widely distant, and necessarily required to be considerably changed before they could be made to work together harmoniously, and the individual excellence and steadiness of each workman was an important element in the perfection of the watch. The whole production was conducted wastefully; each workman requiring but an almost infinitesimal quantity of the raw material, paid a higher price for it than if he could have purchased it in larger quantities, and his individual profit must be greater from his isolated position; every attempt at decoration involving any artistic taste greatly enhanced the cost. If now these various parts were to be assembled in the shop of a watchmaker of high reputation, he must carefully inspect and adjust them before he would be willing to put his name upon them, and a doubling of the price gave him, in his opinion, no more than a fair profit. Thus it came to pass that an Arnold, Earnshaw, Tobias, or Frodsham watch of the first class com-

FIRST CLOCKS USED BY COUNTRY PEOPLE.

Without case, they were fastened to the wall, the weights running nearly to the floor. They kept good time when the children did not play with the pendulum.

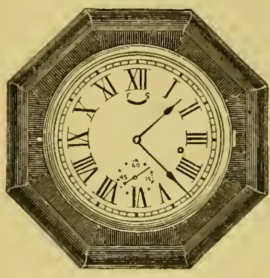
HOUR-GLASS.

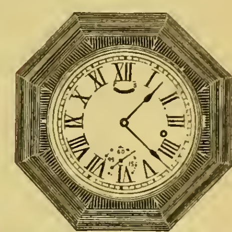
Shaped like wine-glasses, minus the stand part, one inverted, connected together by a small tube, by which the sand passed from one to the other in one hour; it was then reversed and the sand ran back again. Whether our ancestors sat up nights to turn it over we can not tell.

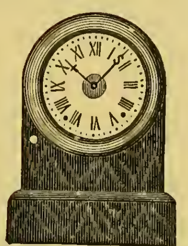


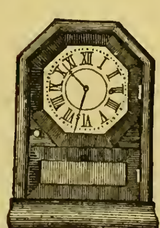
THE SUN-DIAL,

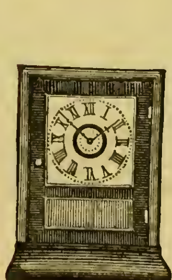
By which our forefathers could tell when it was noon in fair weather. When cloudy they judged by the indications of the stomach.

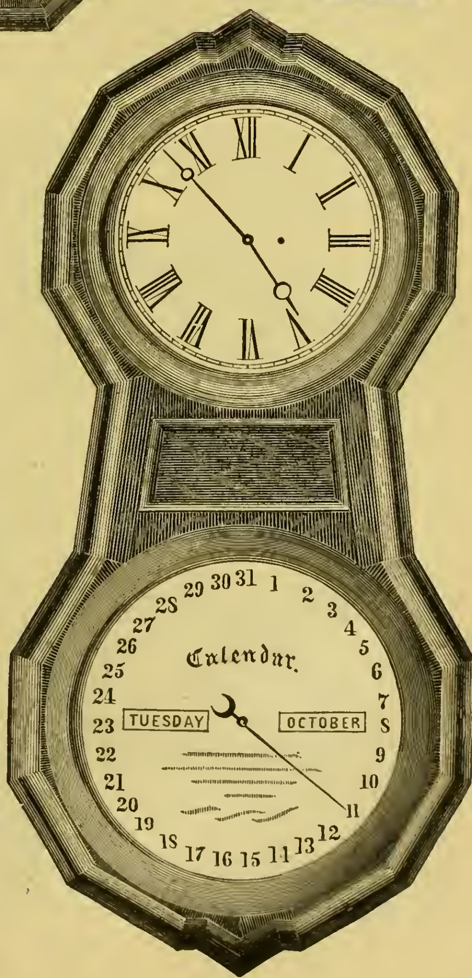




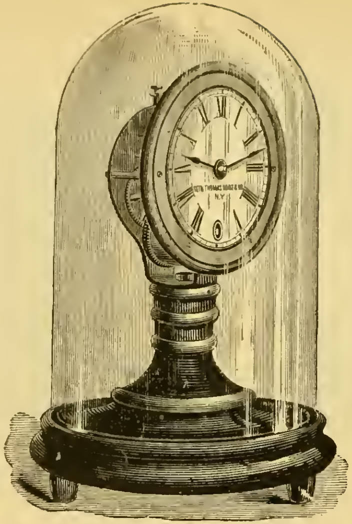






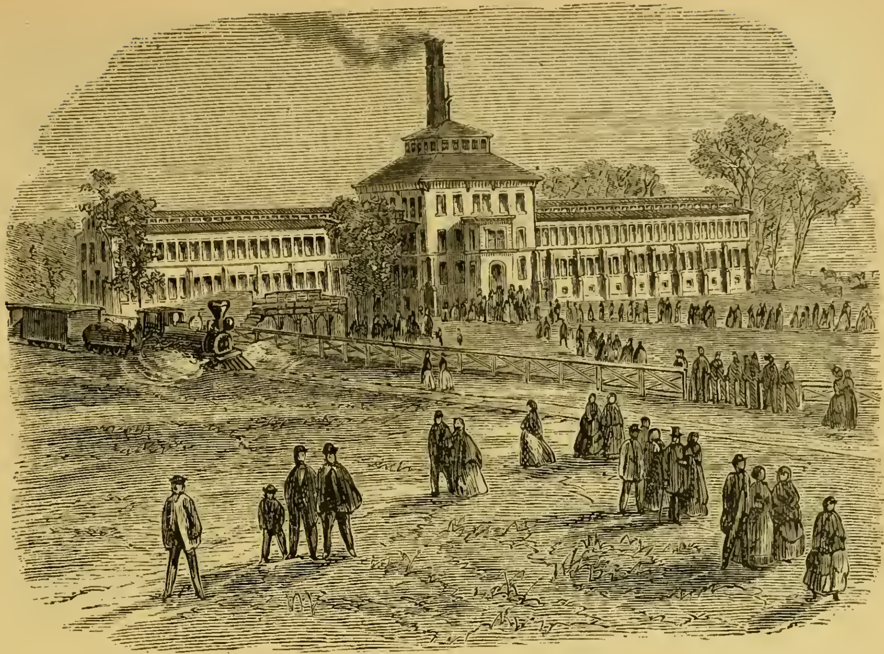



MANTLE CLOCKS—BRONZE CASE AND STATUARY.



MANTLE CLOCKS—GLASS COVER.

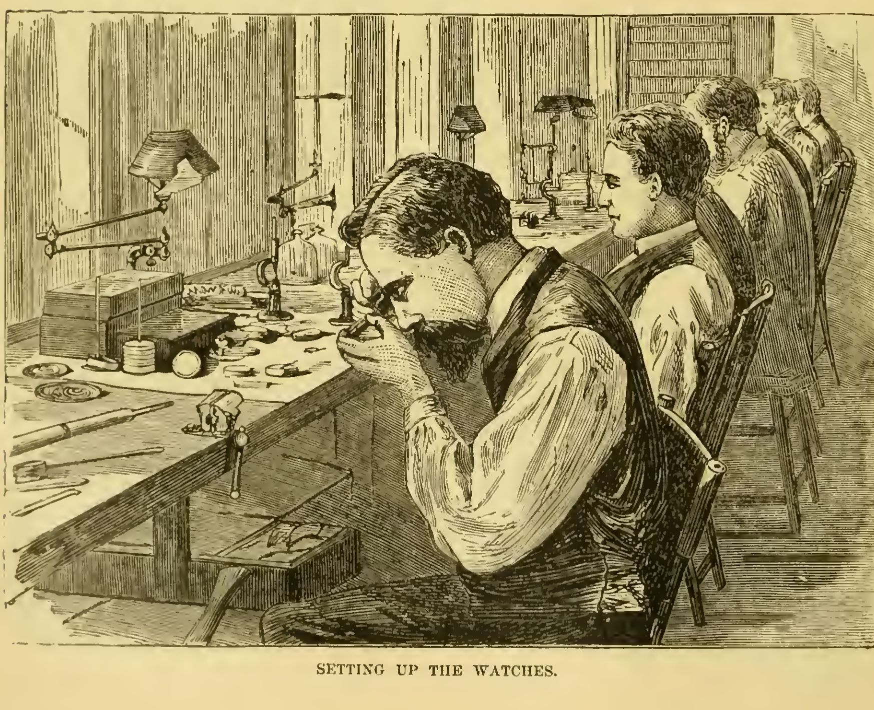
MANTLE CLOCKS—BRONZE CASE AND STATUARY.



VIEW OF THE ELGIN WATCH FACTORY.

THE TRAIN ROOM.

ELGIN MACHINE SHOP.



SETTING UP THE WATCHES.

manded from $200 to $800. If by any accident any part of the movement of such a watch gave way or was injured, all that could be done for it was to make another as nearly like the injured part as possible; it might fit well and do well, sometimes it did; if so, well; if not, the watch, however costly, was rendered worthless. The French and Swiss watchmakers very early abandoned two features of the English watch as unnecessary, and as increasing the size, cost, and fragility of the watch, viz., the fusee and chain and the vertical escapement. In their watches, the great wheel, which had been attached to the base of the fusee, was transferred to the base of the barrel which held the mainspring, and set in motion the center wheel and pinion, which in turn imparted motion to the third wheel and pinion, and this to the contrate wheel and pinion, and thus connected directly with the balance and escapement, which by their alternate motions regulated and compelled uniform action in the uncoiling of the mainspring, and availed themselves at the same time of the action of the hairspring, making its isochronism more perfect. But the Swiss carried the division of labor farther than the English. They employed over fifty different trades in the production of a watch, and often from 150 to 200 persons. While they had some machines for making parts of the watch or case, it was true that of the pieces made wholly by hand, workmen passed their whole lives in making duplicates of the same piece, and that often a very small one, and these workmen worked at their own homes, often many miles apart. Wages were very low, so low that the English watchmakers have for many years past imported the parts which made up the watch movements from Switzerland, put them together, stamped their own names on them, cased them, and sold them at a large profit as English watches. Yet this very cheapness of labor had its disadvantages; there was much imperfect work. The best watchmakers say that more than one-third of all the pieces are rejected by the inspectors, but that it has been the practice of unscrupulous dealers to buy them up, put them together, and covering them with showy cases, send them to distant markets—the United States, South America, Australia, etc.—and sell them at low prices as Swiss watches. These watches were bad enough, though more comely than the "Nuremberg egg;" but they kept some kind of time, and did not vary more than an hour a day; they were practically driven out of the American market by the production of a low-grade American watch, which was a good time keeper, and though cheaply cased was a very durable and serviceable watch; but, driven to desperation, these pseudo-watchmakers are now sending over great quantities of the worst possible trash, plates and wheels not gilded, steelwork unpolished, cases imperfect, and the whole utterly worthless for any purpose, and these bogus watches are sold in gift enterprises, and as rewards for subscriptions to periodicals, and in the thousand ways known only to swindlers. The better class of Swiss watches are very good watches, the best made by hand labor, and though necessarily of higher cost than American watches of the same or a better grade, yet find a moderate market here.

We turn now to the manufacture of *American watches.* This industry, considered as the manufacture of watches mainly by machinery, has not yet reached its thirtieth year. There were, it is true, isolated instances within seventy years past in which ingenious workmen, who had imported the springs, the jewels, the escapement, and the fusee chain, had supplied the remaining parts of a watch movement, and set it up so as to make a serviceable watch; there were numerous instances where watchmakers, having imported all the parts of a watch movement, had put them together and made cases for them; but this was not the manufacture of watches.

To Mr. A. L. Dennison, a watchmaker of Boston, belongs the honor of having, in 1852, been the first to conceive the idea that it was possible, by improving on the systems in force in Switzerland by making the parts of a watch under one roof, operating the tools by steam or water-power, and supplementing them by other machines of American invention and by such hand labor as might be necessary, to create a manufactory which would turn out ten watches a day. Doubts were expressed of his sanity, but he persuaded three other gentlemen, Edward Howard, David P. Davis, and Samuel Curtis, to join him in erecting a watch factory in Roxbury Mass. Difficulties surrounded them from the start. It was after a year of hard and at times almost hopeless labor that they completed their first watch in 1853. They have made hundreds of thousands of more elegant watches since that time than this, their first-born, but it was, and is, an excellent time-keeper. But an unexpected obstacle now met them; the soil of that part of Roxbury immediately surrounding their factory is a fine clay, and in dry weather an almost impalpable dust arises from it, which they found fatal to the more delicate operations required in the manufacture of a watch. Nothing daunted, however, they removed to a site on the banks of the Charles river, a little above the village of Waltham, where other partners soon came in, and the manufactory was first organized as the Boston Watch Co., and some years later, after some financial troubles, reorganized as the American Watch Co., of Waltham, Mass., with its present managers. At first, they had the strong competition of foreign manufacturers, the prejudices of purchasers in favor of foreign watches, and the cupidity of many of the dealers, to contend with, but they have bravely overborne all opposition, and their growth since 1860 has been steady, uniform, and rapid. They now have a capital of $1,500,000, a manufactory covering nearly two acres, with a park in front, an extensive enclosed flower-garden, cottages and other dwellings for their employees, and when running at full time, as they now are, employ about 2,000 hands, half of them women, paying for all their work at such prices that the wages average $1.75 per day for women and $2.75 per day for men. They can turn out from 1,000 to 1,500 watch movements a day, and produce a vast quantity of silver watch-cases also at the factory; the gold cases, and the dust and water-proof silver cases, are made in their Waltham building in New York city, under the careful supervision of Messrs. Robbins & Appleton, who are large stockholders and the general agents of the company. This part of their business consumes a large amount of capital, and yet cannot keep up with the demand. Nearly 1,000 gold cases are produced in a week, and more than $20,000 worth of gold melted, beside the constantly increasing quantity of silver for the dust-proof silver cases. Their silver cases are all warranted $\frac{925}{1000}$ fine, or $\frac{25}{1000}$ higher than American silver coin, and their gold cases eighteen karat fine. They manufacture no cases of nickel or base metal. Their actual production is about 400,000 watches per annum. They have sold in this and other countries, in the twenty-seven years since they began work at Waltham, about two million watches, and have now a rapidly increasing demand for export to Great Britain and all the great consuming markets of the world, and a home market so large that they have great difficulty in keeping up with their orders. The foreign demand has been greatly enlarged since the Centennial Exposition of 1876, the French Exposition of 1878, the Sydney Exposition of 1879–80, and that at Melbourne in 1880–81. The rapidity of the growth of the manufacture of these watches was thus stated by M. Edouard Favre-Perret, a commissioner from Switzerland to the Centennial, and himself a well-known Swiss watch manufacturer, in a speech addressed to Swiss watch manufacturers after his return: "In 1860, the American companies produced only 15,000 watches; in 1863, 100,000; to-day they produce 250,000. We sent to America, in 1872, 366,000 watches; in 1875, 134,000; in 1876, barely 75,000. Had the Philadelphia exhibition taken place five years later we should have been totally annihilated, without knowing whence or how we received the terrible blow. . . . . The Waltham Company make the entire watch from the first screw to the case and dial. It would even be difficult for them to use our products, so great is the regularity, so minute the precision with which their machines work."

It is a most significant fact that this company, not yet thirty years old, and which adopted its own calibers for its watches, entirely independent of and differing from those of the Geneva makers from twenty to twenty-seven years ago, should have attained such a status that, except in the complicated repeating and other watches not made here, many of the Geneva makers have changed their calibers, and made them conform to the American standard, so that many foreign watches (except as above noted) will fit into a Waltham case. The Waltham works are, in one very important sense, the only complete watch factory in the United States; they case their own watches, while all the others make watch movements only, leaving them to be cased by the dealers, who buy their cases where they can buy best. The evils of this practice, the Waltham people say, are manifold; there is no satisfactory guaranty, in most cases, of the fineness of the case; it is often carelessly and imperfectly made, and so may injure a really good and perfect movement. It is never really dust-proof or moisture-proof, and this is especially the case with stem-winders and stem-setters; it is never so perfectly adapted to the watch movement as a case made especially for that pattern and no other. A large manufactory with ample capital and the best machinery, made by its own machinists, and buying, melting, and assaying its material on a large scale, has great advantages over the small manufacturer, while in decorating or engraving the cases, their superiority is complete.

The Waltham Company have not only fully maintained the guaranty with which they provided every watch of their manufacture from an early day after their establishment at Waltham, "that it is made of the best material, on the most approved principles, possessing every requisite for a reliable time-keeper, and that for any defect in material, workmanship, or performance under fair usage, the Company at all times hold themselves responsible;" but they have availed themselves of every opportunity of improving and perfecting their watches, until they should be, in the highest sense, even the lowest grades, "instruments of precision." Long before 1870 they had made their highest grade of watches, stem-winders, and stem-setters as well. Nearly two-thirds of their watches are now stem-winders and stem-setters, the key-winders being almost entirely of the less costly grades, or if of the higher, those intended for the London market, as John Bull clings to his old habits with great tenacity. All of their best watch movements, and especially all those intended for the use of travelers, railroad men, mining and civil engineers, have the "quick train," insuring a swift motion of 18,000 beats to the hour. The reasons for this are that the wheels and pinions revolving quickly, the balance itself spinning with great velocity, shocks and other disturbances, while the watch is in motion, exert very little influence upon it. This is particularly true with watches carried by railroad engineers and conductors, and mining and civil engineers. Severe shocks do not perceptibly alter the rate of such a watch. These improvements in some form are, we believe, adopted by several of the American companies. Fogg's patent pinion, whose office is to prevent the breaking down of other parts of the watch if the mainspring breaks—a most ingenious contrivance—is an invention exclusively used by this company. The chronograph, a timing watch which works out the minute subdivisions of time through an attachment not affecting the main watch, and records them down to one-fifth of a second on the face, or on a dial on the back of the watch, is another of their remarkable additions which will be appreciated by the sporting fraternity. There is very little demand for what are known as fancy watches—under which general title are included repeaters, watches which give the days of the month, the time of the sun, moon, and stars' rising and setting, the signs of the zodiac, or the precession of the equinoxes, in this country, and as they are greatly complicated in their machinery by these additions, and so more liable to run irregularly, none of our American manufacturers have been disposed to make them. Perhaps one of their best improvements, so far as the safety and regularity of action of the watch is concerned, is their dust and water-proof case. Several of the companies have had contrivances for diminishing the amount of dust which is liable to enter a watch, such as dust-proof bands, etc., but the American Watch Company have devised a case which has not only a dust-proof band, but a screwing together of the two halves of the case outside of this band, and a cementing of the heavy crystal so completely and by such admirable mechanism as to render it entirely impervious to either dust or water. The watch, well and carefully oiled when put together, will run perfectly, does not need to be opened for five years, and then does not require much cleaning. There are well attested instances where watches with these cases have lain for three months in snow, ice, and water, and at the end of that time have been wound and set, and were none the worse for their bath. These watches are in great demand at the west, and in tropical countries, where the constant moisture to which they are exposed would soon ruin an ordinary watch.

The American or Waltham Company is

by no means the only manufacturer of watch-movements in the country, though it was the first and is much the largest. The exact number of these companies at the present time we cannot give. A few of them have a deservedly high reputation. The first, we believe, was that of Mr. Edward Howard, one of the original members of the American Watch Company, who withdrew from it at an early date, and established himself in Roxbury, Mass., in the manufacture of watches, chronometers, regulator clocks, and tower clocks. Mr. Howard has not attempted to produce so large a number of watches as some of the others, his production ranging from fifty to sixty watches a day, and employing about 250 men, but his watches, like all his time-pieces, are of excellent quality, and all of the higher grades.

In 1864–65 several companies were organized. The most prominent and successful of these was the National Watch Co., established at Elgin, Illinois, and now generally known as the Elgin National Co. The capital ($1,300,000), as well as the enterprise, which originated this company came from Chicago, but some of its earliest and best workmen were from the Waltham Company's works. It is much the largest company, after the Waltham Co., in the United States, employing 700 or 800 hands, more than half of them women, and turning out about 600 watch movements a day (or 175,000 to 180,000 a year), of sixteen different grades. They make no cases, preferring to have their movements cased by the dealers. They have a demand for their movements in Europe, and export considerable quantities of them thither, as well as to other countries. Their agency in London was not successful, not from lack of merit in their watches, but from other causes. Their watches of the higher grades are excellent time-keepers, and like all the better class of American watches, have good lasting qualities. They have gone very largely into the cheaper grades of movements, which, though without compensating balances, are very fair time-keepers, and sold as low as the cheap Swiss watches, while for permanent value and accuracy they are infinitely preferable to them. The New York Watch Manufacturing Company, at Springfield, Mass., the Springfield, Ill., Watch Co., the Cornell Watch Co., now, we believe, given up, the Rockford, Illinois, Co., the Lancaster, Pa., Watch Co., the Philadelphia Watch Co., and the Waterbury Watch Co., of Waterbury, Conn., are the only others of which we have any knowledge. The last named exhibited its watches at Melbourne, Australia, in 1880–81, but by some misfortune failed to make a very good showing, while the American Watch Company, which also exhibited both there and in Sydney, carried off the chief honors. The Waterbury Company are said to make fair cheap watches, but like several of the other companies named, their establishments are not large.

And now let us attempt to describe what an American watch is; for though differing in some minor details, the American watches are substantially alike. We will take the Waltham watch as our type. The foundation of the watch is what is technically called the plate, which is in reality two plates, an upper and lower, between which the train or running gear, except the balance-wheel and hairspring, are placed. In these plates are drilled the twenty-one holes for the jewels on which the axles of the wheels revolve, and for the tiny screws which hold the jewels in place. These plates, which are of hardened brass, or, in some of the movements, of nickel, are drilled, and if of brass are gilded, and then sent to the engraving-room for such lettering as is to be placed upon them. The jewels, whose use has been already described, and which in American watches are always of ruby, chrysolite, garnet, or aqua-marine, and finished with great care—the pivot-holes, or the perforation for the pinions of the wheels, varying according to the size of the watch movement, $\frac{1}{300}$ to $\frac{1}{1200}$ of an inch in diameter. The finest movement made by the American manufacturers has sixteen jewels; the cheapest has seven. The jewels having been inserted and fastened in their places by the infinitesimal screws, the axles of the wheels of the train are inserted in these minute pivot-holes, and the wheels being geared to each other, the watch-movement is "set up." The American watch-movement has no fusee or chain; its mainspring and going-barrel store the power which is to move the wheels of the watch; the escapement and compensating balance let out this power in regular motion; and thus regulated, it is distributed to the hands of the watch, through the toothed wheels and the pinions that fit them.

All the American manufacturers use the anchor escapement only, and however firmly they may be constructed and adjusted by means of their true compensating balances, and with the aid of the most minute regulators, micrometrical or excentrical, they are always lever watches. The anchor escapement is by far the best for all practical purposes, keeping under proper compensations almost absolutely accurate time, with less liability to get out of order, and requiring far less care in handling (and very few people are as careful as they should be of a good watch), than the far more costly chronometer escapement. All the wheels of the American watch-movement are stamped out in blanks from the hardest brass, and the teeth cut by machinery in quantities of from 50 to 1,500 at a time; but this, which is a very simple matter in the ordinary wedge-tooth wheels, is far more difficult in the epicycloidal-toothed wheel, and in the peculiarly shaped tooth of the escape wheel, of both of which we give an illustration, and each tooth involves six different operations. The epicycloidal tooth is one of the great discoveries of clock and watch mechanism; it has many advantages over any other form of tooth for a watch wheel, and is now in use in all the best clock and watch movements. The number of teeth on a 'scape wheel varies with the different sizes and grades of the escapements, but in the American watches is seldom an even number. The machine which produces them is a very ingenious one; 30 to 50 of the blanks are slipped upon a rod and screwed in a firm, compact mass, and then put into the escapement-wheel machine. On the cylindrical face of the machine are six revolving cutters, each pointed with sapphire; and as the rod with the blanks upon it passes automatically along the cylinder, one of these cutters ploughs through the thirty wheels, making a deep furrow; as the rod comes back, the cylindrical face has turned one-sixth round, and a second cutter is ready to do its work at a different angle from the first, and so on till each of the six cutters has performed its part and one tooth is finished. The process is repeated—the blanks being turned automatically the space between each two teeth each time—till the whole number are cut, when the machine throws itself out of gear, and waits for another set of blanks to be fed to it. The epicycloidal goes through the same number of operations, though in an entirely different machine.

The number of parts or pieces in an American watch range from 156 to 162. The most striking peculiarity of the American watch movements, and one which gives them an immense advantage over all hand-made watches, is that every part, even to the infinitesimally-small screws, is exactly duplicated thousands of times, so that any broken or defective parts can be sent by mail to any part of the world, if the number of the watch is known. The perfection to which the higher grades of American watches have attained as timekeepers is marvelous. The reports of the Centennial Exposition, and the Paris, Melbourne, and Sydney expositions of 1878, '79, and '80, where the large majority of the judges were foreigners, and most of them watch manufacturers themselves, and where all the watches offered for examination were subjected to the most rigorous tests to ascertain their rate of variation for many days, and their uniform award of the highest medals and prizes to the American Waltham watches, on all points, is conclusive on this subject. And yet in neither of these exhibitions were the highest grades subjected to the test. A thoroughly well made watch, on whose adjustment a year's time and $100 expense may have been lavished, may work admirably under these severe tests, but what the public want to know, and what these tests demonstrate to them, is, that an ordinarily good watch, such as a railroad conductor or engineer needs, will, without any long or careful adjustment, keep almost absolutely accurate time, and can be offered at a very low price, and warranted. An order for 1,000 watches for the use of the railroad engineers and conductors on the India railroads, was filled by the London office of the American Watch Co., after the most rigid testing and examination at an average price of $21.25. The cases were solid nickel by government direction. The order could have been duplicated in silver cases at a lower figure, but it was far below that of any of the English or Swiss manufacturers, while the watches were much better timekeepers than those of their competitors.

## ELECTRO-PLATING

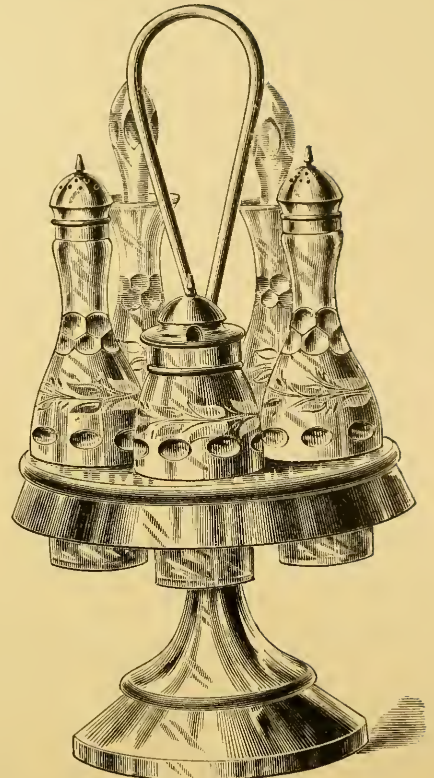
Electro-plating is the art of depositing, by means of electro-galvanism, upon the surface of the baser metals, copper, brass, nickel silver, britannia or white metal, &c., a film or coat of silver or gold. The discovery of the process followed that of electrotyping, describec elsewhere in this work, and was made about 1839 by Mr. C. J. Jordan. Previous to 1839 silver-plating or gilding was executed in the old way or various ways. Iron was gilded by polishing its surface and then heating it till it acquired a blue color. When this was done, leaf gold was applied, slightly burnished down, and exposed to a gentle fire, after which it was burnished again. Copper or brass may be gilded in the same manner. Gilding metals by amalgamation was effected by forming the gold into a paste or amalgam with mercury, and was chiefly employed for gilding silver, copper, or brass. The metal being well cleaned, is dipped into the amalgam or spread over with it, when a quantity will adhere to the surface. The metal is then exposed to the heat of a furnace, which volatilizes the mercury, leaving the gold adhering; this is afterward burnished. In this way, buttons and similar articles are gilded.

Ornamental figures were also delineated in gold upon steel by a very ingenious process, by means of ether. Gold was dissolved in nitro-muriatic acid, and a quantity of ether was added, and the mixture shaken. The ether taking the gold from the acid, an ethereal solution of gold was produced, which was separated and applied to the surface of the steel by a camel hair; the ether was evaporated, leaving the gold on the surface of the steel. The metal was then heated and the gold burnished. In this way sword-blades were ornamented. Instead of ether, the essential oils may be used.

Making gilded trinkets was brought to such perfection that the use of real gold was very much diminished. The most elegant patterns were struck in thin copper, and then gilded so perfectly as not to be distinguishable in a general way, while new, from gold, and with proper care they would last for a considerable time; but when the gilding once wore off, the color could not be restored, as in the case of jeweler's gold. These were the processes in use up to 1839, when Mr. Ames was one of a committee sent to England by the government to acquire knowledge in aid of a government arms manufactory, and his attention was attracted to the subject of depositing silver by electricity, which was then being discussed, and its theory established. No process of depositing the silver upon any base metal, as nickel silver, had been discovered. Subsequently, pursuant to some suggestions of Professor Silliman, it was discovered that cyanide of potash would hold the silver in solution without oxidizing the baser metals. This removed a part of the difficulty, but there yet remained to deposit any given weight of silver that might be required. This was also removed by the addition of the cyanide of silver to the solution.

The early process was to dissolve sulphate of copper in a vessel, and to suspend a zinc plate by wires soldered to it, and the object to be coated by the same wires in the liquid facing the zinc and very near to it. On the application of the electric battery, the zinc dissolved, and about the same amount of copper deposited itself upon the object to be coated, which was attached to the negative pole of the battery. A quantity of sulphate of copper was suspended in bags in the upper portion of the liquid to supply that which deposits. In electro plating with gold or silver, there should be a constant motion sustained, in order to aid in equalizing the deposit. In plating, the utmost care is to be taken to remove all traces of grease by boiling the object in alkali. This process was extensively employed for depositing a coating of silver upon german silver, britannia, pewter, or brass, by which the apparent beauty of the precious metal was imparted to them. The mode of dissolving the silver was originally by pure nitric acid; distilled water then being added, the silver is precipitated as a cyanide by a solution of cyanide of potassium. The precipitate being collected and washed, is dissolved in a solution of cyanide of potassium, and this is used for silver, in place of the sulphate of copper used for the deposit of that material. The object is more conveniently obtained by connecting a plate of silver with the positive pole of the battery, suspended in a solution of cyanide of potassium, and allowing the current to pass until the silver begins to deposit upon the negative pole. The copper wire is then attached to the object, which is dipped in nitric acid, and then placed in the solution; after being in it some minutes it is taken out and well

NO. 45.—ICE PITCHER.—MERIDEN BRITANNIA CO.,



NO. 7.—COMBINATION ICE WATER SET.—MERIDEN BRITANNIA CO.,

brushed with sand. It is then replaced in the solution, and in a few hours' time it will have acquired a coating of dead white silver as thick as tissue paper. It may then be burnished or polished with a hard brush and whiting. A later process deposits the silver with a brilliant surface. To produce the natural hardness of the hammered metal, it is requisite to preserve certain proportions between the size of the silver plate and the object to be plated. If the time of the operation is prolonged, the deposit may be thickened to almost any extent. To deposit a plate as thick as ordinary writing paper, will require 1¼ or 1½ ounces of silver to twelve square inches. The pure metal thus deposited is as durable as that used for silver coin. By the electro-plating process, all ornaments, however elaborate as designs, however complicated they may be, can be produced in as great perfection as in solid silver.

The adaptation of the electro-plating processes to the production of table-ware, etc., is not yet forty years old in this country. It was first started in Great Britain, in 1840, by Joseph Shore and George R. and Henry Elkington, all of Birmingham. The Elkingtons used copper as their basis at first, and have continued in the business to the present time, making vast fortunes out of it. In this country, the first electro-plated wares were made by the Cowles Manufacturing Co., in East Granby, or Bloomfield, Conn., in 1846. They were unsuccessful, and failed; but out of their failure sprang two firms which have attained eminence in the business. Asa Rogers, of Hartford, had been connected with the Cowles Company, and after its failure started the business of making plated forks, spoons, etc., with his brothers in Hartford, and originated the Rogers Brothers firm, subsequently merged in the Meriden Britannia Co.

Samuel Simpson, of Wallingford, Conn., then engaged in the manufacture of britannia ware, visited the Cowles Manufacturing Co., in 1846 or 1847, and attempted at first to use the electro-plating process on his Britannia wares, but finding the composition too soft to burnish well, abandoned it, and used a much harder white metal, composed of block tin, copper, antimony, etc., which had already been tested in England, and with this succeeded in making very fine goods. At first he found the jobbers unwilling to take his goods, as they were making more money on the inferior English goods; but selling to the retailers he soon brought them to terms. Now there is not only very little electro-plated ware imported, but we export largely to all civilized countries. Mr. Simpson has still an active interest in the electro-plating business, with which he has maintained his connection through several firms, being for ten years one of the leading men in the Meriden Britannia Company, and now at the head of the large manufacturing house of Simpson, Hall, Miller & Co., of Wallingford, Conn., and New York.

There are many establishments engaged in the manufacture of these electro-plated goods, and the annual production is nearly twenty millions. The largest manufacturers, not only in the United States, but in the world, are The Meriden Brittania Company, who have eight large factories at West Meriden, Wallingford, Conn., and elsewhere, and salesrooms of great extent and beauty in 46 E. 14th st., New York, in Chicago, San Francisco, and Hamilton, Ont. They employ an average of 1,200 hands, and make wares of more than 30,000 patterns on nickel, silver, and albata, or white metal, and of single, double, triple, or quadruple thickness of plate. They have long been distinguished for the artistic beauty and variety of their ornamental designs, many of which, drawn by their eminent artists, are unsurpassed in excellence. They have introduced all the styles of finish of solid silver and gold goods, the hammered, repoussée, and the so-called Russian finish, in which the goods are oxidized with gold, and have enamel designs in various figures. Their new illustrated catalogue for 1882, just issued, is itself a miracle of art, and cost them more than $40,000. It has over 2,000 illustrations of goods of the following classes: tea sets and waiters; castors; individual castors, peppers, salts; pickles and salad stands; celerys, wine stands; epergnes, fruit stands; ice cream and berry dishes; knife-rests, nut bowls; dessert sets, sugars, creams; cake and fruit baskets; butter dishes; spoon holders, syrup cups; cups, prize cups, napkin rings; jewels, card stands (a new design of these has a portrait stamped in the center); toilet wares, vases; candlesticks, cake dishes, tureens, vegetable dishes; hotel ware, bar goods;

biscuit jars, sardine boxes; ink stands, jardinieres, cigar holders, and boxes; tobacco and match boxes; teapot stands, paper-weights, communion ware; nickel silver, art work; spoons and forks, and as a specialty, what they call sectional plate, spoons and forks reinforced at the points of greatest wear by extra heavy plating; plated knives, and fancy special knives and forks; solid silver spoons, forks, etc., cased goods of great beauty, call-bells, star salts, etc. This dry catalogue, while it exhibits the immense variety of their manufactures, for there are several dozens of designs for each class, gives no idea of the exquisite beauty of many of the goods. The annual sales of this company, which has been in existence nearly thirty years, exceed $4,000,000.

Another house of nearly equal extent and longer in the business, is the firm of Reed & Barton, established at Taunton, Mass., in 1824, for the manufacture of Britannia wares, and engaged in the production of electro-plated goods since 1847. Their wares have the highest reputation for beauty of design, solidity and durability of plating, and excellence of finish. They sell largely throughout the United States and in all civilized countries, their goods displacing the famous "Sheffield wares" of Dixon, the English manufacturer, wherever they are brought in competition with them. They manufacture many thousands of different designs, employ about a thousand workmen, and do a business well up in the millions. They have fine salesrooms in Boston and at 686 Broadway, New York.

The house of Simpson, Hall, Miller & Co., of Wallingford, Conn., and 36 East 14th street, New York, probably ranks third in the business. They manufacture all descriptions of electro-plated table-ware, both in nickel-silver and white metal; have about 20,000 designs, many of them of great beauty, and are constantly adding new ones; employ between 400 and 500 hands, and produce goods annually to the amount of $700,000.

The Meriden Silver Plating Co. is not very far behind the Wallingford Co., either in its patterns, the number of its employés, or the amount of its annual product. The Middletown Plate Co., at Middletown, Ct., produces much excellent work, and has a high reputation. It employs about 150 hands. Hall, Elton & Co. are also an old and successful house. These and many others have been long engaged in electro-plating, and all of them produce very fine goods.

In electro-gilding the metal is dissolved in nitro-muriatic acid, when the chloride of gold thus obtained is digested with calcined magnesia. The oxide precipitated is washed by boiling in nitric acid, and is then dissolved in cyanide of potassium. The temperature in gilding copper should be at least 130° F., and in gilding silver still higher. The positive plate of the battery must be of gold, and the negative of iron or copper. Some of the metals, as iron, steel, and lead, do not readily receive the gold in deposit, but being first covered with a light coat of copper the gold is deposited upon that. The solution should contain as much gold as will perfect the desired work at once. In this operation very small quantities produce extraordinary effects. An ordinary watch-case may receive a heavy coat on the outside, and be well covered within, and yet the expenditure of gold will be only twenty grains, or the value of $1.50. "A magnificent gold pencil case" will have taken three grains, or twenty-two cents. Many of the cups, flagons, toilet and flower vases, salts and peppers, spoons, etc., of the electro-plating companies are gold-lined, *i. e.*, have a thin film of gold deposited on the silver, which answers an excellent purpose in keeping them from oxidizing or turning black.

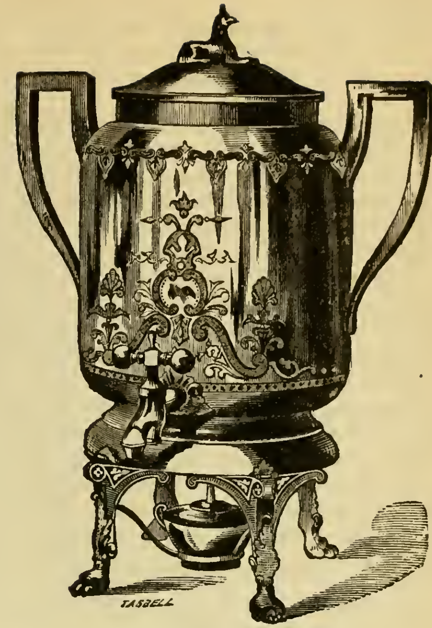
Nickel-plating is a new form of electro-plating which has made a great progress since 1870. Nickel makes an admirable coating for many articles, from its hardness, silver-like surface, and slight tendency to oxidization. It is largely used in the sewing machine manufacture for ornamental trimmings, as well as in harness, carriages, lamps, buttons, lever clocks, etc. Experiments, long and carefully conducted, have recently demonstrated that it can be rendered as malleable and easily worked as silver, and that some of its new alloys are excellent substitutes in manufacturing for gold and silver.

In this connection, something should be said of the manufacture of solid silver and gold goods. These are articles of luxury only, and there is very little demand for them, until a country has become wealthy and prosperous; they are, thus, a test of its progress in wealth, and the ability to indulge in luxuries. At the beginning of the present century, there were not, in all probability, one hundred customers throughout the country, in any one year, who would have been willing or able to purchase a set of silver plate for family use. Every article of this kind was imported from Europe, and at heavy cost; and even there, their use was confined to the tables of the very rich—silver table and teaspoons having taken the place of those of wood, horn, and pewter, between 1760 and 1790. About 1820, the manufacture of silver spoons was commenced in this country. A bar of silver was heated in a common blacksmith's forge, rolled to the proper thickness by rolls operated by a windlass, and then hammered into shape. Each spoon in course of manufacture had to be heated nine times before it was finished. Two men, by hard work, could make two dozen teaspoons in a day, no two of which were alike in shape or weight. After some years, thimbles, combs, and a few napkin rings were also produced. It was not till after 1830 that some machinery, driven by horse-power, was introduced in this manufacture, and forks, children's cups, and a few other small articles added to the number of American manufactures of silver. Mr. Jabez Gorham, of Providence, R. I., was, probably, the pioneer in this business, having commenced in a moderate way in 1831. To have attempted the production of tea or dining sets at this time would have been as foolish as it was impossible. The machinery and the skill to make them were both wanting, and no sets for table-service which lacked the "Hall mark"—the British coat of arms—stamped upon them as evidence of their purity, could have been sold to an intelligent purchaser. The first marked indications of progress occurred between 1840 and 1850. Some eminent jewelers, who were importers of silver wares, desired to become silversmiths also. Among these were two firms in New York, Tiffany, Young & Ellis, afterward Tiffany & Co., and Ball, Tompkins & Black (a firm name subsequently changed). They had commenced business about 1840, and with laudable ambition sought to lead in every department. At first, their efforts were confined to the smaller wares—spoons, forks, napkin rings, etc., etc., of which they produced new and elegant patterns. It was not till about 1850 that they made any efforts for the production of hollow ware of solid silver. Both firms, and especially the first, have made great progress since, and they now employ a large force of workmen, and have produced, besides table and communion services, many vases, groups, and fancy pieces of wonderful beauty and rare artistic skill. But working in silver has been, with them, hardly more than an incidental portion of their vast business, and not its chief object and end.

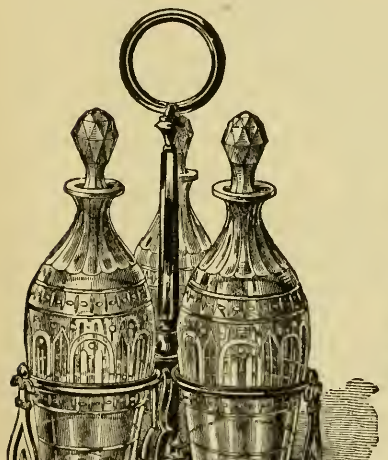
When, in 1850, only a generation ago, Mr. John Gorham, the son of the founder of the Gorham Company, decided to commence on a large scale, and with machinery driven by steam power, the manufacture of all descriptions of silver goods, the act was one of greater courage than has often been witnessed in business circles. The enterprise was entirely new to this country; there had been no efforts, at least no successful ones, to produce hollow ware goods of solid silver here. Spoons, forks, napkin rings, children's cups and the like were made, but these only within a few years with the aid of some simple machines. Even in Europe, the greater part of the labor was performed by hand by skilled workmen, and a careful investigation made in person satisfied Mr. Gorham that there were few, if any, machines in use there which it would pay to import or copy. The machines must be invented for the work here, and the material was so costly that there must be no blundering. The workmen must be imported, for there were no hands skilled in this work here; and these workmen, whose skill in hand-labor was their most valuable possession, must be taught to do by machinery much which hitherto had been done by hand. Then there was the purchasing public, as yet not large in numbers, but increasing, whose confidence must be gained, and who now firmly believed that nothing American could be as good, as valuable, or as artistic as the products of European workshops. They must be educated, also, to comprehend that the absurdities and crudities which they now so greatly admired were unworthy of regard, and that the highest art was that which drew its inspiration from an intimate communion with nature.

The financial aspects of the enterprise were not especially assuring. It required a large investment of capital, with very small returns for some years, and if there should be panic and disaster, there was a probability of its utter failure. But Mr. Gorham was a man of strong faith and great patience and perseverance, and, after numberless difficulties and disasters, he achieved a grand success. To-day, the great factory of the Gorham Company employs 500 skilled workmen; among them designers of the highest genius, and artificers whose skill in hand-work, the result of years of patient endeavor, is not surpassed anywhere; its name is favorably known in every civilized country on the globe for the artistic beauty of its designs and the perfection of its workmanship; while the stamp of the company is a higher guarantee of the purity of its wares than the *Hall mark* of the British silversmiths. Their warehouse in New York is one of the wonders of the metropolis; and every article there, whether for use or ornament, and every decoration and design in relief, draws its lines of beauty from the only true school of art—the teachings of nature. They have added to their factory at Providence a department for the production of electro-plated wares, and these are of such exquisite beauty of design and excellence of finish that they can only be distinguished from the sterling silver plate by the marks of the manufacturers, and the fact that the same design is never used for both kinds of goods. Whether this great company have amassed a colossal fortune, by its more than thirty years of persevering toil and achievement, we know not; it has certainly accomplished a nobler and better work; it has educated a nation to a juster and truer comprehension of the beautiful in nature and art.

CHASED ICE PITCHER.



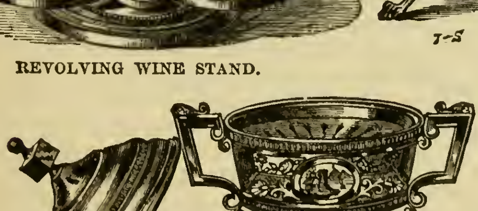
CHASED URN.



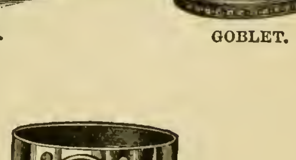
REVOLVING WINE STAND.

CASTOR.

GOBLET.



BUTTER DISH.



NAPKIN RING.

## FISHERIES.

The fisheries were the first successful industry of the colonies, and they laid the foundation of our national commerce and marine. The results are not singular in this respect, since the most flourishing commercial countries of the modern world owed their origin, like the Romish church, to the "poor fisherman." When the subjects of ancient Rome, flying before the hordes of Attila, retreated to the lagunes of the Adriatic, nothing remained to them but the sea and its treasures. This pursuit enabled them to rear on the rocks that had sheltered them, the proud Venice which awed the world, and whose power fell only when the republic had become a corrupt oligarchy, and the young general Bonaparte, the agent of a new republic, called them to account. With the same origin, Genoa grew into the dominion of the seas, and encountered the same fate when wealth and corruption succeeded the humble virtues of the founders. The Dutch, from a band of herring-catchers, whose collection of fishing huts was called Amsterdam, carried on that system of energetic industry that conquered Holland from the sea, and prevented the future encroachments of that element by dikes; while the country grew rich and so powerful that the successors of those old herring-busses carried a broom at the masthead in token of the sovereignty of the seas. To them succeeded the English, whose fishing-nurtured marine, coupled with an aptitude for commerce, gave them the mastery over the wealth-enervated Dutch. The English felt the maritime sceptre tremble in their grasp for the first time, when the New England trained fishermen met them in battle, and almost every engagement resulted in the triumph of the "bit of striped bunting." But warlike supremacy is the least of the triumphs, since the commercial and maritime superiority has every day become more manifest, from the moment when Paul Jones "began to fight" and "old Stewart" out-manœuvred the English fleet, to the success of the yacht America in the British waters. The vigor and address with which the New Englanders early embarked in the cod and mackerel fishing, and built vessels with which to prosecute it, not only excited the admiration of the mother country, but roused the alarm of the government, who foresaw, in their industry and intelligence, the causes of the defeat they sustained a century later.

About the time of the Declaration of Independence, the trade growing out of the cod fishery furnished the northern colonies with nearly one half of their remittances to the mother country, in payment for goods. All the seaport towns were engaged mostly in it, and thus grew in proportion to the success of that business. Under these circumstances, the fishing rights were a very important part of the negotiations entered into at the peace. The general result of the negotiations was that the Americans might catch fish anywhere except within three miles of certain English colonial coasts, and might land to dry and cure on the southern side of Newfoundland and other convenient coasts. Congress, by law, also granted a bounty to vessels of which all the officers and three fourths of the crew were American citizens. This bounty was continued, in one form or another, till 1874, for a considerable period; in an allowance of so much per ton, and afterwards in some special privilege, such as a drawback on imported salt, etc., etc. Nearly $15,000,000 was paid out in direct bounties—almost the whole of which went to fishermen in all the New England states (except Vermont) and New York.

The fisheries, and particularly the cod and mackerel fisheries, have been a constant source of difficulty between the United States and the British Provinces, now the Dominion of Canada. The first treaty regulation was in 1783, which gave liberty to U. S. fishermen to take, cure, and dry fish along the coasts of the Provinces, but not in settled districts without the consent of the proprietors of the lands. In 1818 a convention made at London limited these concessions somewhat, and the stipulation was exacted from the U. S. that in all the coasts not named by the treaty they should not take fish within three marine miles of the coast, but they might enter the bays or harbors thus excepted for purposes of shelter, repairing damages, or obtaining wood and water. In 1854 the Reciprocity treaty was negotiated; this, while confirming the previous privileges, allowed also fishing, curing, and drying fish at other points not specified in previous treaties, when it did not trespass on private property, but gave Canadian fishermen the same rights on

WHALE FISHERY.

COD FISHERY.

Before the construction of railroads, the whole number of halibut annually caught and brought into Cape Ann did not exceed 2,500, which were nearly all sold fresh for immediate consumption; for not having been in demand, when cured in any manner by salt, for the domestic or foreign markets, but few were prepared for that purpose. In fact, so worthless were they considered as salted fish, that the owners of the vessels employed in the fisheries generally instructed the crews to cut adrift all the halibut which were drawn up, and every year many thousands had been thus turned back to the deep with a fatal wound. But such was now the facility of transporting them *fresh* to the New York market, that at least 16,000 were taken, and a large portion of them sent to that city by the railroads and steamboats.

The mode of taking halibut is as follows: The lines are thrown over and allowed to sink to the bottom; a heavy lead is attached, for the undercurrent on the Banks is very strong; the fish takes the hook by suction, but the force of suction is sufficient to enable the fisherman to discover that he is "thar;" then commences the "hauling in," and the reader may believe it is no joke to haul in a line, in a rough sea, of some eighty or ninety fathoms in length, with a fish of from twenty-five to two hundred pounds' weight at the end. Sometimes the fish comes up very readily to the surface, but in most cases it is necessary to "drown" it, by drawing it some ten or twenty feet from the bottom, and very suddenly letting go. This last process is of course a very tedious one. The fish, upon coming to the surface, is seized by a "gaff," an oaken pole or stick with a strong hook attached, drawn on board the vessel, and thrown into the ice-house. Each man keeps account of the number of fish he takes, of which he receives the proceeds from one-half the amount of sale.

Formerly the halibut was only caught late in the spring and during the summer and autumnal months, on the south shoals of Nantucket, along the coast of Cape Cod, in Barnstable Bay, on Cash Ledge, and some other places, where they were most abundant at certain seasons of the year, and always in deep water, being considered, as it is termed, a *bottom* fish. But since the demand for this American turbot, as it may with propriety be called (for it much resembles that delicious fish in form and flavor), has so vastly increased, the fishermen have made explorations in search of other haunts, and, to their great astonishment, found them in immense quantities on George's Banks, early in March; and what was still more surprising, and a fact until then entirely unknown to them, they appeared in extensive shoals on the surface of the water, like mackerel, and were taken with but three or four fathoms of line, instead of from twenty-six to seventy, which they had been accustomed to use time out of mind in the *bottom* fishing. The Cape Ann vessels take from two hundred to five hundred each trip, weighing from twenty-five to two hundred pounds. The fish is packed and shipped mostly, if not altogether, in Boston, and thence sent to the most distant points of the south. It much surprised the epicures of New Orleans when it popped out of the ice-box in the market, not only by the strangeness of its appearance, being altogether unknown in those parts, but also by the delicacy of its rich flavor.

The growth of this fishery has been so rapid that from a small beginning it has in a few years increased to $125,000 per annum, and employs one hundred nearly new and well-adapted vessels, chiefly owned at the port of Gloucester.

The mackerel fishery was one of the earliest pursued, but it did not reach much importance until the close of the last century; and it is now mostly confined to Maine and Massachusetts. There are now about 30,000 tons employed in it, and the number of barrels caught annually will vary from 131,000 to 360,000 barrels. Nearly the whole of the business is carried on in Massachusetts, the other states doing but little in it. A few vessels from Maine and Connecticut fit out at Gloucester, the chief place for that industry. The merchants of Philadelphia, New York, and Boston have their agents at that place to purchase and ship for them. There are now employed in it over 1,000 vessels, and 10,000 men. The value is given as follows by the inspector general of Massachusetts:

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|---|---|
| Value of vessels and outfits in Massachusetts, | $6,032,000 |
| Value average of catch, | 4,400,000 |

The American mackerel-catchers took of this fish one year as follows: 188,336 barrels in American waters, and 140,906 barrels in waters now claimed as the exclusive right of the Earl of Derby.

Gloucester sends out annually about four hundred schooners, ranging from 65 to 110 tons, and averaging 90 tons. Their crews for the mackerel fishery generally consist of from ten to fourteen men, according to the size of the craft; for the cod and halibut fishery, of about eight men. The vessels are nearly all of a clipper build, fore-and-aft rig, and are valued at an average of about $4,000. Most of them have all the conveniences of a mechanic's house on shore, and their cabins will generally compare, in a due proportion of course, with the cabins of any merchant-ship. It is the fisherman's pride that his craft shall compare in beauty with any other he may meet. In Gloucester the value of shipping tonnage is $1,600,000. In the months of May and June, nearly all the vessels owned in the port commenced "fitting out" for the Bay of St. Lawrence, in which locality, for the past few years, mackerel abound in the greatest numbers. The "fit-out" consists in the craft being newly painted, rigging and sails renovated, anchors and cables replenished, if necessary, men shipped, and bait, salt, and provisions taken on board. She is then ready for a start. For the first few days of the passage all hands are busily employed in arranging or deciding for their fishing quarters at the rail. The best men are generally given positions near the main rigging, which is considered the most advantageous, as the fish usually rise there in greatest numbers. The men are shipped "on shares," as it is termed, *i. e.*, each man is entitled to one-half the fish he takes—the other half going to the vessel. After about a week's sail they arrive at their destination, which comprises the Bay of St. Lawrence, from Cape Breton Island on the south and Prince Edward's Island on the west to the mouth of the St. Lawrence on the north. When arrived, bait is got up and ground. The "toll-bait," as it is called, is generally menhaden, or porgies, a small bony fish, little used as an article of food. This is supplied in great quantities to each vessel. It is finely ground in a mill provided for the purpose, then mixed with water, and it is ready for use. Upon the appearance of a school of mackerel, which is indicated by a rippling of the surface of the water not unlike that of the schools of herring, the vessel is "hove to," and the "toll-bait" thrown. The fish will generally follow this bait to the side of the vessel, where all hands are at their quarters, and anxiously awaiting the first "bite." And now commences a general excitement. Each man has his barrel by his side, and to those who have never seen the operation, the rapidity with which the fish are taken from the water is almost incredible. The men are also provided with two lines each, and upon a "strike," which means when the fish bite rapidly, these lines are in constant motion, and what seems strangest of all is the fact, that although a space of only about a foot and a half or two feet is allowed to each man for himself and his barrel, it is very seldom that the lines become entangled, even when the school being at some distance from the vessel, some fifteen or twenty fathoms of length of line is required, and the fish, as soon as the hook is felt, dart hither and thither with the rapidity of lightning. After a "deck" of mackerel is obtained (which signifies a goodly number of barrels), all hands immediately prepare to put them in salt. The operations of "passing up," "splitting," and "gibbing" are gone through, and they are packed in salt in the barrels. Another direction in which the fisheries were of comparatively little importance twelve or fifteen years ago, but where they have suddenly attained a great magnitude, is the lake fisheries, and especially those of the lake white fish, salmon-trout, the lake herring, and sturgeon. These fish are sent to market, fresh, salted, frozen, and smoked, and caviare, isinglass, and oil are prepared from them. As late as 1870 this industry occupied only a comparatively few hands, and produced not more than $825,000. In 1879, there were 43,122,270 pounds of fish reported, and the total value of fishery products on the great lakes was $1,784,-050, an amount which is rapidly increasing every year. The river and small lake, inshore fisheries undoubtedly aggregate more than any others. The shad fishery alone is of great magnitude, amounting to about $1,200,000 annually, and the bluefish, weak fish, rock and black bass, perch, pickerel, pike, porgies, roach, flounders, flatfish, Spanish mackerel, bonitas, eels, lampreys, lance fish, the muscalonge, lake-trout, brook-trout, graylings, and some twenty other species of fish with which the markets of all the country are supplied make an immense aggregate.

The oyster trade is a large one. The oysters are of numerous varieties, partly depending upon the locality where they are fatted. Many of them, in the original beds, are unfit for market until they have been transferred to a favorable locality for them to fat. The different localities impart to them various flavors, more or less salt, and which are difficult to discriminate otherwise than by the name of the place where they were fatted, as "East Rivers," "Shrewburys," etc. The setting, planting, and bringing them to market occupy a great number of men and no inconsiderable tonnage. They attain a remarkable size in about eighteen months, and breed very rapidly. When the oyster vessel arrives in the spring from the south, it is anchored near the site of the proposed bed. The cargoes are then put into small boats that come alongside. The beds having been staked off into small squares, about fifty bushels are spread over one of the squares in such a manner that no oyster shall be upon another. By the fall, the oysters will have considerably increased in size, and greatly improved in flavor. If allowed to remain too long in sheltered waters, the oyster not long acclimated will perish with the rigor of the northern winter. The breeding time of native oysters is in April and May, from which time to July or August, they are said to be sick, or *in the milk*, and in most localities laws forbid taking them until the first of September, with a view to favor their growth. They are then caught in a net, which has on its lower edge an iron scraper. This being attached to a rope and cast over from a boat, is dragged along the bottom by a forced motion when rowed by the fishermen. The iron scraper turns up the oysters and they are retained in the net, which from time to time is drawn up to be emptied. When the water is shallow a pair of hugh tongs are used to pick up a number at a time. In some places the drag or dredge is very large and heavy, and is drawn along by the vessel under sail. The process is forbidden by law in some districts, since the heavy drag crushes and destroys as many as it catches. When the season sets in, the fishermen crowd the waters where the oysters are to be had, and sell their catch in the neighboring cities. The larger dealers buy their oysters in Virginian waters, and carry them north to plant until they are fat. There are, however, occasional discoveries made of native beds in Long Island Sound, or in some of its estuaries, which in size are nearly equal, and in quality superior to the finest transplanted Virginia bivalves. One of these, a few years since, discovered near Huntington, L. I., has proved of great value; another discovered in 1881 is said to be still larger and likely to be of greater importance. The Virginia oyster trade was for some years previous to the war of great importance. In 1858, about 16 million bushels, worth not far from 8 million dollars, were taken from the Virginia oyster beds. During the war this trade was entirely suspended, and supplies were drawn from Baltimore and Chesapeake Bay, and from the New Jersey and Long Island oyster-beds. The price went up, but the supply was as great and the quality as good as ever. Baltimore is one of the great marts of the oyster trade. In 1862, thirty-three oyster firms of that city packed 1,500,000 bushels of oysters, those sold in the shell netting $700,000, and about $3,-200,000 worth being opened, canned and packed for exportation the same year. In 1869 the business is said to have reached over fifteen millions of dollars. The number of hands employed was about 16,000. In 1880, the aggregate exceeded $20,000,-000. New York city now ranks next to Baltimore in this trade. Oysters are now largely exported in the shell to England. From $8,000,000 to $10,000,000 are the proceeds of the oyster trade in that city. Fair Haven, Conn., is also very largely engaged in the trade. The native oysters, or what are considered such, being propagated from old plants, are taken mostly for the city trade, while the transplanted oysters find their way all over the country by railroad. To preserve them, they are first opened and put into kegs or cans of a capacity of twelve to twenty gallons each. These are then put into boxes and surrounded with ice. There are some 450 vessels employed in carrying oysters to New Haven. There are about 20 houses engaged in the business, the largest having branches in Buffalo, Cleveland, Hamilton, and elsewhere. These firms employ a great number of boys and girls in opening the oysters. The operation is performed with incredible dispatch by the experienced hands. The instruments used are a hammer to crack the edge on a slip of iron fixed upright in the bench, and a knife. The latter is always held in the hand, while the hammer is seized, the blow given, and dropped, the knife inserted, and the oyster, being seized between the knife and the thumb, is pitched into the tub. The movement produces a constant click-gouge-splash, click-gouge-splash, as the tub rapidly fills with the "bivalves" previous to packing. The openers formerly received two cents a quart, and earned from $1 to $2 a day. There are 150 oysters to the gallon, and to earn $2, 100 quarts, or 3,750 oysters, must be opened, or during twelve hours fifty per minute! They now get four cents a quart.

One of the most remarkable fisheries is carried on in Long Island Sound and some other localities. It is the taking of menhaden or bony fish. These fish go in immense schools, which show themselves in ripples upon the surface of the water. They are taken by nets, which may be seen by the steamboat traveler, hung upon immense reels at the water's edge to dry. These nets are weighted with lumps of lead at the lower edge, having floats at the top, so as to keep them upright in the water. The fishers, in boats, pay out the net from one and the other, and encircle the school with it. The two ends then being carried to the shore, are drawn in with great force, and an immense haul of fish results. With the bony fish, many of a better class are caught, but if the aggregate will not equal 150 cart-loads it is not thought large. This branch of the fishing industry, long carried on in a desultory way, for the purpose of using this supposed worthless fish for manures, on the sandy alluvium of the shores of Long Island, is now thoroughly organized, and fleets of small steamers with their boats are engaged in taking the fish, while several hundred factories are engaged in expressing the oil, which finds a ready sale, and preparing a guano made from the scrap. From 300 to 400 millions of these fish are caught annually.

The whale fishery began at the close of the 17th century in Nantucket, and that has been, until very recently, its chief location. About the close of the revolutionary war, Massachusetts employed 183 vessels, of 13,820 tons, navigated by 4,059 men, and producing about 2,000,000 per annum. The business progressed until the American seamen nearly drove all others from the seas in that pursuit. England, to encourage her whalers, imposed a duty on foreign oils, but finding her fishermen coming home very frequently without oil, while her wants were great, and the American whalers offering to supply them, "caved in," and took off the duty, in order to encourage her own manufacturers. Our own whalers have never had the bounty of the government, like the cod fishery, to encourage them, but have on the other hand been compelled to encounter the opposition of "prairie whales," which yield their lard oil, and the enormous production of petroleum oils, and illuminating gases, while from the growing scarcity of whales, which are deserting their old feeding grounds, the extreme difficulties and dangers of the business are continually increasing. Nevertheless, the hardy American seamen continue to chase them, even into the extreme Arctic regions, whither the whales resort, as it was said by an old "ship's lawyer," to supply the "northern lights" with oil. The business is conducted in a peculiar manner, differing from any other fishery. The voyage being projected by the owners, the officers and crew are shipped on "lays," every man having an interest in the voyage. If the voyage is not successful he gets nothing, but if the usual success is met with, he gets a certain number of gallons proportioned to the whole, and is thus interested in the price as well. The shares of officers and men equal one third of the whole. Of late years the whale fishery in the Atlantic ports has fallen off sadly, the number of vessels decreasing every year. New Bedford, which once had a whaling fleet of nearly 500 vessels, has now but 134, and New London, Conn., Fair Haven, Nantucket, Westport, Mass., and Sag Harbor, L. I., which once had from 100 to 150 vessels each, have but forty altogether each. The fishery is more active in San Francisco and other Pacific ports. San Francisco has fitted out twenty-five or thirty whaleships annually, but the number is not increasing. In 1859 there were 185,728 tons of shipping employed in the whale fishery, and the year previous, 198,594 tons, the highest point ever reached; from that time to


FOOD FISHES OF THE SEA—EXHIBITED IN THE UNITED STATES BUILDING.

the present there has been a great falling off; in 1875, there were 38,229 tons, and in 1880, 38,408 tons, only about one-fifth of what found employment in 1858.

## FISH CULTURE.

Fish Culture is the name given to an industry whose beginnings in this country, in 1853, were very small, but which has now attained a magnitude and influence which are astonishing, and which augur great and valuable results in the near future. We believe every nation in Europe has now its Fish Commission, and many of them associations for fish culture, while in the United States there is an admirably efficient National Fish Commission, organized in 1871, state commissions in almost every state and territory, with numerous hatcheries east and west, the establishment of the American Fish Culturists' Association in 1871, and of many minor organizations since. Large sums have been expended by individuals for this object, and nearly $1,500,000 by the national and state governments.

The object primarily had in view by these commissions and organizations was to increase the number and, as far as possible, improve the quality of the supply of food fishes in the various states and countries in which they act. They have succeeded in demonstrating that an acre of water devoted to the propagation of fish will yield a larger and surer crop than can be produced by any ordinary process from an acre of land. The processes by which this result can be accomplished are simple and not very expensive, especially under the liberal arrangements of the National and State Commission. Fish culture is based on these considerations: 1. That the possible annual increase of fish, though greatly varying in different families, tribes, genera, and species, is yet, at the lowest, enormously large. 2. That of this increase, of which nearly nine-tenths is lost in nature, certainly eight-tenths may be saved at a comparatively small expense by artificial impregnation and hatching. 3. That the food on which the fish subsist in the water is not, except in rare instances, a source of any expense to man. 4. That though, perhaps, in most parts of this country the supply of food is as yet sufficient for the demand, and with some room for export, yet the variety resulting from a greater use of fish as diet is healthful, and leaves a larger margin of other food articles for export, and with our constant and rapid influx of immigrants, who are for a considerable period non-producers, and the sudden climatic changes which may greatly diminish our crops, as they have recently, there is a certainty that wise measures are needed for the increase of the food supplies.

Let us briefly sketch the progress of fish culture, and then state what is its present status in our own country. It is now generally acknowledged that Stephen Ludwig Jacobi, 1707–1784, a wealthy landed proprietor of Hobenhausen, in the Duchy of Lippe, Germany, was the first practical fish culturist in the world. He commenced the artificial impregnation and propagation of trout and salmon in 1724, and he and his descendants continued it till 1825; he wrote largely on the subject, brought it to the attention of learned societies, and was very successful in his efforts to increase greatly the numbers of these excellent food fish. He was indeed somewhat before his time; but learned and scientific men took up the subject, and as early as 1770 not only was his work known in Germany, but it had been published in a translation in France. Something was done, in a practical way, in Germany, especially in Lippe, from 1820–1827, but not much elsewhere till about 1840. In 1837 John Shaw began in a small way experimenting on the eggs and young of salmon, and in 1841 Gottlieb Boccius raised young trout at Oxford and Chatsworth. In 1842–44 Remy and Gehin, two French fisherman of the Vosges, successfully practised fish culture, and it was established in Switzerland about the same time. In 1843–44 Dr. Barrett, of Middletown, Conn., began to advocate it, as indeed Dr. John Bachmann, of Charleston, South Carolina, had done as early as 1804. Quatrefages' work, a standard authority, was presented to the French Academy in 1848, and the French government took measures to promote it about 1850. It was commenced in Alsace and in Norway the same year, and in Finland in 1852. In 1853 Dr. T. Garlick and Prof. H. A. Ackley, of Cleveland, Ohio, succeeded in propagating brook trout artificially; Kellogg and Chapman did the same thing in 1855, N. E. Atwood in 1856, Muller and Brown in 1857, Ainsworth in 1859, and Seth Green in 1864. The Massachusetts Fish Commission commenced its work in 1856, but was not efficiently organized till 1865. Between 1857 and 1871 ten states had established fish commissions, and salmon, whitefish, shad, lake and brook trout, cod, and pike-perch had been successfully propagated, and Seth Green, of Caledonia, N. Y., had been the first man in the country to make the artificial propagation of fish commercially profitable. In 1871 the American Fish Cultural Association and the National Fish Commission were organized. Between that time and 1881 the shad and the eastern salmon were introduced successfully into California, Oregon, and Washington Territory, the whitefish, land-locked salmon, salmon trout, grayling, black bass, shad, eels, and many other food fishes, into eastern lakes and rivers, the carp, from Europe, into American lakes and ponds, and some efforts made to do the same thing with the sole and turbot, successfully hatched and distributed the young cod, mackerel, halibut, the Spanish mackerel, and other hitherto rare fish in the inshore and coast waters of the U. S. The return of full-grown salmon and shad to several rivers which they had long deserted were secured, the operations for fish culture greatly extended, fish commissions having been formed in most of the remaining states and territories. The members of the different fish commissions had also invented many contrivances for the more certain success of the processes of fish hatching and preservation. In 1880 the U. S. government built a large steamer, the Fish Hawk, for the National Commission, to be used exclusively for their work of the discovery, impregnation and propagation of food fishes. In the spring of 1880 an International Fishery Exhibition was held in Berlin, Germany. At that exhibition the United States received six of the ten gold medals, one of the five silver medals, one of the seven bronze medals, and two of the fifteen honorable mentions. The fruits of these fifteen years of earnest work are beginning to be seen in the increase of our best food fishes, but there is abundant room for still greater exertions, and the work should not cease until all our waters are abundantly supplied with the best genera and species of food fishes to be found in any part of the globe.

The labors of Hon. Spencer F. Baird, Chief Commissioner of U. S. Fish Commission, of Hon. Frederick Mather, Livingston Stone, William Clift, F. N. Clark, N. W. Clark, Prof. Theodore F. Gill, G. Brown Goode, C. G. Atkins, Seth Green, R. B. Roosevelt, E. G. Blackford, Major T. B. Ferguson, and others, in promoting this good work, have been worthy of all praise.

The methods of fish impregnation and hatching differ with different fish, and can best be learned by those who propose to engage in it by addressing the U. S. Fish Commissioner at Washington, Hon. Spencer F. Baird, LL. D. If he who causes a blade of grass to grow where none grew before, is, as has been said, a benefactor of the human race, how much more he who renders watery wastes fruitful in nourishing and delicious food.

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## ICE.

"Hast thou entered into the terrors of the snow, or hast thou seen the terrors of the hail?"—Job.

For how many years, not to say centuries, was the vast icy wealth which nature confers upon northern latitudes in such profusion, and within reach of every individual, utterly unappreciated and neglected! The use of ice was indeed known to the luxurious few in remote ages. The ancient Romans learned to cool their choice wines with frozen water, and almost in every age the "upper ten" were acquainted with its merits. Like education, and suffrage, and freedom of opinion, and toleration in religion, it however became known to, and extended among the people, only under our federal government. It is now no longer regarded as exclusively a luxury, but has become a necessity. Under almost all circumstances, water is made palatable by it, and wines are improved by its application. The introduction of water into large cities by aqueduct, is made acceptable to citizens not only in the summer but also in the winter by the use of ice. The excuse for ardent drinks based on poor water, is removed by the possession of ice, since tepid water is rendered attractive by it. When water is thus rendered agreeable, the temptation to indulge in strong drinks is diminished. By its use, also, the supply of food is virtually enhanced, since

TROUT FISHING.

the surplus of districts, that might otherwise be lost, can be sent to a considerable distance to supply the wants of large cities. The surplus supplies that may thus accumulate, can be preserved for a longer time by the use of ice. The fruits of the West Indies may be preserved in the northern cities, and those of our own orchards are by the same means preserved for the markets of India, Brazil, and the West Indies. Packet ships no longer carry live fowls and pigs, since a small ice-house may be packed with fresh provisions for the voyage. The markets of all large cities are provided with hundreds of ice-chests, in which fresh provisions are preserved free from taint. Fishermen have become greatly dependent upon ice, which enables them to keep a large and full supply of fish in every variety, and almost every family has its refrigerator or ice-box, which, regularly supplied, is the recipient for butter, milk, and other food. Thus families are as readily furnished with ice as with milk. To country houses and substantial farmers, ice-houses have become a necessity for the same general reasons.

Not the least important use of ice is its medical applications. It is a reliable tonic and of the safest. In cases of fever it has become of general use. In India the first prescription of a physician is ice, and sometimes it is the only one, and the ice is always American! If India sends us her opium, she gets as valuable a return in ice. That article is also a styptic, and has many important medical applications. All these benefits and many more were annually provided for humanity in the frosts of winter and in the congealing of water, but were disregarded until an enterprising Yankee adopted the notion of harvesting that crop. Massachusetts to be sure has but two crops, and it required two centuries to discover them. For more than 200 years the snow fell upon and melted from her granite hills, before speculation, putting its hand upon them, sent them along the coast by schooner loads as material for palaces. For more than 200 successive winters the clear and sparkling ice showed itself upon her ponds, and vanished under the vernal sun, before enterprise detected in its preservation the means of increasing human enjoyment. Those frozen lakes were each winter covered with gold, but, like that of California, it was long undiscovered. It will, however, never run out, since, without ploughing or sowing, nature sends the annual crop, which like the manna has only to be gathered, and the market for it is ever increasing.

There were many farmers possessed of ice-houses in the middle states, at a date as far back as the formation of the government. But the idea of making a trade of it seems to have occurred first to Frederick Tudor, Esq., of Boston, in 1805. He shipped a cargo in that year from Boston to Martinique. The ice was cut with axes, and carted in wagons to Gray's wharf, Charlestown, where it was shipped. The voyage proved a total loss, as did several succeeding ones, until the war put an end to trade. Mr. Tudor resumed it at the peace, and persevered in face of continued losses, until 1823, when he extended it to the southern states, and the West Indies, and it began to pay. As long as it was a losing business he had it all to himself; as soon as his perseverance had mastered the business and made an art of it, he began to have competitors.

The use of ice extended itself in all the cities of New England, and in Boston became very general. The quantity used in the city is about 150,000 tons per annum, against about 27,000 tons in 1847. The ice is cut mostly from Fresh and Spy Ponds; at the former the houses are capable of containing about 130,000 tons. The price of ice for shipping is usually $3 per ton, and rises from that to $9 after midwinter. The article is served to families at the rate of $10 for the season, May to October, for nine lbs. per day; fifteen lbs. are served for $12, and twenty-four lbs. for $16. When large quantities are served, the price is 25 cts. per hundred, and $4 per ton to hotels, when 500 lbs. per day are taken. In New York the quantity used is more than a million tons. This is supplied in varied proportions from Rockland Lake, Highland Lake, New Rochelle, Athens, Rhinebeck, Kingston Creek, Catskill, and Barrytown. In a favorable season, about 1,400,000 or 1,500,000 tons are stored, as there is considerable waste and loss from floods, fires, the sinking of boats, etc. Of this quantity the Knickerbocker Ice Company secure from 750,000 to 900,000 tons, and the rest is stored by the other companies. In an unfavorable season, a warm, mild winter, they may not be able to store half this quantity; but the Knickerbocker Company has its ice-houses on the Kennebeck or Penobscot, and secures as much as is needed there, and the other companies buy from Maine companies. At such times the price of ice, especially to families, rises to a fearful height, reaching in some cases $1.50 or more a hundred pounds. It commenced at Syracuse in 1844 for the supply of a saloon, and it was gradually extended to butchers and families, and the quantity there used is about 25,000 tons, taken mostly from Onondaga Lake, from which it is drawn two or three miles to be stowed in an ice-house. The other cities of western New York have followed the example, and the average price is 35 cts. per hundred. Cincinnati used to draw its supply of ice from its own vicinity; but the railroad facilities permit of drawing it cheaper and better from the lakes. Chicago is well supplied from the same source. In the neighborhood of Peru, Illinois, a large quantity is cut for the supply of the lower Mississippi. It is cut in the winter and packed in flat-boats which are allowed to freeze up in the Illinois river; there is therefore no other ice-house needed. As soon as the river breaks up in the spring, the boats float down stream and supply the markets below. In Philadelphia, Baltimore, and Washington, ice is more important than in the cities of the North. When the weather sets in cold in the early part of the winter, they cut ice in the neighborhood, but the best supplies are from Boston or from more northern lakes. The Atlantic and Gulf cities of the South get most of their ice from Boston, which sends them about 110,000 tons per annum, and further quantities to Havana and the West Indies. Rio Janeiro, Callao, and Peru, Charleston, Mobile, and New Orleans, are large customers of Boston in the article of ice. In New Orleans, substantial brick ice-houses have been erected at a cost of $200,000, and similar arrangements have been made in Mobile for its distribution. The quantity exported to Europe is large, and England takes about 1,000 tons of American ice.

It follows as a matter of course, that where this object of industry and enterprise is formed by nature, the means of conducting the trade will gather around it. Hence the land in the immediate neighborhood of fresh-water lakes at the North rises in value, and good wages come to be earned in the winter by men who at the dull season would otherwise not be employed. The question soon presented itself to those who were engaged upon cutting ice on the same pond as to their comparative rights. This was settled at Fresh Pond by a committee, who decided that each owner should hold the same proportion of the contiguous surface of the pond as the length of his shore line is to the whole border.

The time for cutting is December and January. The "experts" can in the middle of January estimate the value of the crop. When the ice is sufficiently thick to cut, say from nine to twenty inches, the former for home use and the latter for exportation, if there should be snow upon the surface, it is removed by wooden scrapers drawn by horses. There is a layer of what is called "snow ice," that is not fit for market; this must be removed, and for this purpose an iron scraper with a cutting-edged steel is drawn over it by a horse. A man rides upon the scraper, which in its progress cuts several inches of the snow ice from the surface of the clear and glittering article that is to go to market. When this is completed, the field of ice is marked off into squares of five feet each. The marker is drawn by a horse, and is guided by handles like a plough. In the tracks of these marks and cross marks follows the cutter. This is a remarkable invention, which has reduced the cost of cutting ice in the neighborhood of Boston alone, some $15,000 per annum. Acres of ice are thus cut into square pieces, which are then floated off through canals, and impelled by long poles, to the sides of the pond, where inclined planes lead up to the ice-houses; up this inclined plane each piece is dragged with great celerity by a powerful steam engine. In the house it is directed by hand down other planes to be packed away by the requisite number of men. By the aid of steam ten tons of ice may be cut and housed in a minute. With a full power, it is not uncommon to stow 600 tons an hour. Sometimes there are several parties on the pond, each vieing with the other in the rapidity of their operations.

Most of the ice-houses that we have seen are built of wood. Sometimes they are found of brick. They are very high and broad, and are usually from 100 to 200 feet in length. Fresh Pond, Cambridge, Mass., has its shores almost covered with some fifty of these ice-houses. They present a singular appearance, neither looking like barns nor houses; and one unacquainted with the ice business would be almost certain to ask, on

Fig. 1.

ICE HARVESTING.
CLEARING THE ICE OF SNOW.

Fig. 2.

MARKING AND CUTTING THE ICE.

Fig. 3.

SAWING AND BARRING OFF.

Fig. 4.
CANALING TO THE ICE-HOUSE.

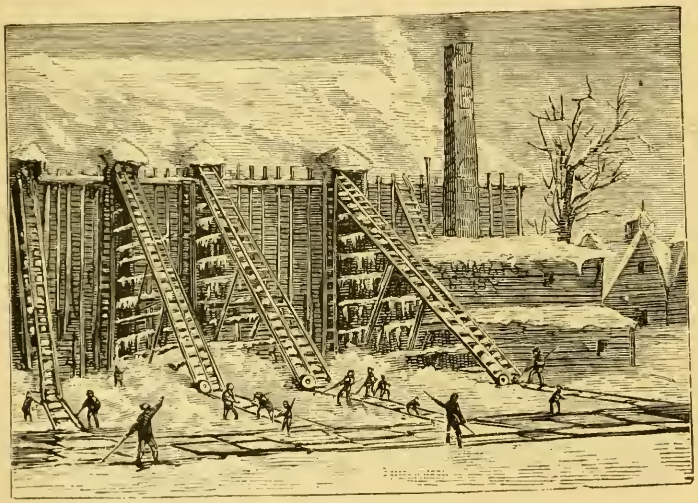

Fig. 5.
THE ELEVATORS.

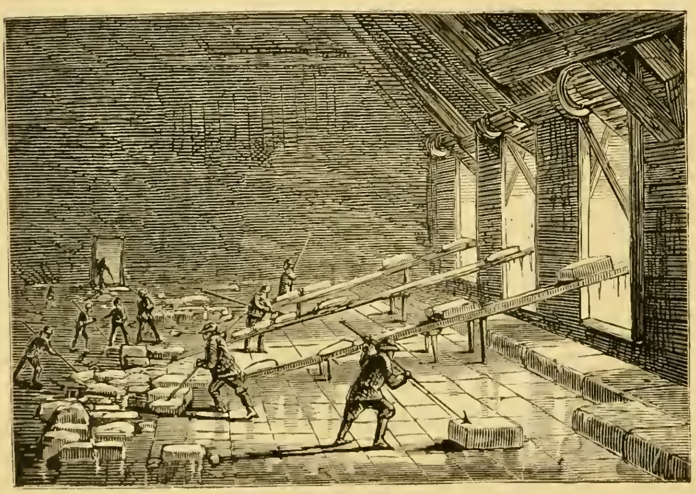

Fig. 6.
PACKING AWAY THE ICE.

seeing them for the first time, "What are they?" The construction of these houses, in which ice is to be stored until sold, must be regulated by the climate—the amount to be stored—the material nearest at hand—and the facility of reaching the shore—the object being to have a cool spot, where the influence of the sun and a warm atmosphere shall be least felt. Added to this, the mass of ice must be preserved as much as possible from wasting, by being surrounded by sawdust, tan, shavings, rice-hulls, charcoal, or leaves, which must be used in the ice-house, or aboard ship, according to circumstances.

Private ice-houses are constructed in different ways. They were formerly merely cellars; they are now in the most approved methods erected above ground, with a drain under the mass of ice. The opening is generally to the north, and the ice is the better preserved for a double roof, which acts as a non-conductor. The waste of ice is different under different circumstances; shipping ice should not waste more than 40 per cent.; and when shipped on an India voyage of 16,000 miles, twice crossing the equator, and occupying some months, if one half the cargo is delivered it is considered a successful voyage. The cost of the ice delivered is of course affected by this element of wastage. In Boston, it is $4 per ton; in Calcutta, 2½ cts per lb., or $56½ per ton. The very high price of ice, even at the north, when the winters are mild, and the increasing demand for it for refrigerating ships and cars, as well as for the southern cities and large towns has led to many experiments for the manufacture of artificial ice. Some of these have been successful. Ice machines have been imported from Halle, in Saxony, from France, from England, and other countries in Europe, and some good machines have been made here. Perhaps the best is one which produces freezing effects by the evaporation of ammonia, and its recovery. This produces intense cold at a moderate price, and can be used for cooling water and other liquids to a very low point, as well as in the actual production of ice. It is in use in a large number of breweries, and produces the low temperature in the refrigerating chamber of steamships which carry fresh meats, etc., for European markets. It has also proved a great boon to southern cities and towns.

When Daniel Webster took his farm at Marshfield, his ice-house cost $100, and it was filled annually at an expense of $25. In that he preserved his fresh meat and fish, and prevented his butter from "running away." Sometimes farmers live in sight of fine ponds that would give a plentiful crop, that might be harvested and sent by railroad to good markets, without ever bestowing a thought upon the matter. To get $2 or $5 for hauling, would pay their otherwise idle teams at that season well. We may close this notice by an extract from an oration of the Hon. Edward Everett, as follows:—

"When I had the honor to represent the country at London, I was a little struck one day, at the royal drawing-room, to see the President of the Board of Control (the board charged with the supervision of the government of India) approaching me with a stranger, at that time much talked of in London—the Babu Dwarkananth Tagore. This person, who is now living, was a Hindoo of great wealth, liberality, and intelligence. He was dressed with Oriental magnificence—he had on his head, by way of turban, a rich Cashmere shawl, held together by a large diamond broach; another Cashmere around his body; his countenance and manners were those of a highly intelligent and remarkable person, as he was. After the ceremony of introduction was over, he said he wished to make his acknowledgments to me, as the American minister, for the benefits which my countrymen had conferred on his countrymen. I did not at first know what he referred to; I thought he might have in view the mission schools, knowing, as I did, that he himself had done a great deal for education. He immediately said that he referred to the cargoes of ice sent from America to India, conducing not only to comfort, but health; adding that numerous lives were saved every year by applying lumps of American ice to the head of the patient in cases of high fever."

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## PINS.

The manufacture of pins has reached a great development in the United States, where the most important invention in the art of making them, that of "solid heads," originated. So simple an article as pins formerly required a great manipulation in their production, but are now, like most articles that have been the objects of American ingenuity, produced in great perfection and abundance by machines. Up to the war of 1812, pins, like almost every other article of manufacture, were imported, and, as a consequence, became very scarce when communication was interrupted, and the price rose in 1813 to $1 per paper, of a quality much worse than are now purchased for 6¼ cts. per paper. These high war prices prompted the manufacture, and some Englishmen commenced the business at the old State Prison, at what was called Greenwich village, now a part of New York city. The labor of the convicts was employed in the business. The return of peace bringing a deluge of cheap pins from abroad, put an end to that enterprise. The tools used in the manufacture at the prison fell into the hands of a Mr. Turman, who in 1820 undertook to employ the pauper labor of the Bellevue Almshouse in the manufacture, which was, however, unsuccessful. "Pauper labor" here, it seems, could not compete with pauper labor abroad. A machine had been invented during the war, for making pins, in Boston, but it did not work successfully. The old pins had the heads put on them; but Mr. L. W. Wright, of Massachusetts, invented a machine for making solid-head pins. He carried this to England and operated it there, and the first "solid-head" pins were sold in the market in 1833. In 1832 a pin machine was patented in the United States by John J. Howe. The machine was designed to make pins similar to the English diamond pins, the heads being formed of a coil of small wire fastened upon the shank by a pressure between dies. In December, 1835, the Howe Manufacturing Company was formed in New York for the purpose of manufacturing with this machine. The company moved to Birmingham, Connecticut, where it continues operations with a new patent for manufacturing solid-head pins, got out by Mr. Howe in 1840. In 1838 another company was started at Poughkeepsie, notwithstanding that by an extraordinary oversight pins were under the tariff admitted free of duty, while the wire of which they were made paid 20 to 25 per cent. duty. In 1846 there was much excitement in respect to the pin manufacture, and many machines were invented; few of them, however, succeeded in doing good work. Most of the attempts to manufacture failed. The Poughkeepsie Company was, however, sold to the American Pin Company, Waterbury, Connecticut. About the year 1850 the copper from Lake Superior began to be used for the wire, giving an impetus to the business, and 250 tons were used per annum. Great improvements were made by self-acting machinery superseding a process that formerly required six or seven hands. The old method of sheeting pins, or sticking them on paper, was a tedious process; a good hand could stick five or six dozen papers in a day. By the improved machinery now in use, a hand will stick from 75 to 125 dozen a day, and do the work in far greater perfection. There are three patents in force for improvements in the machines in use for this operation, viz., those of S. Slocum, De Gras Fowler, and J. J. Howe. The present price of American solid-headed pins is only about two thirds of the lowest price at which imported pins of the same weight were ever afforded before the manufacturing was introduced, and for service they are undoubtedly better than the article of which they have taken the place. The American improvements in both the pin-making and the pin-sticking machinery have been for several years in operation in England and some other parts of Europe.

One firm in Waterbury, Connecticut, have in operation an improved machine for the manufacturing of pins which turns out *two barrels* per day. A barrel contains 4,000,000 pins, consequently the product of that little manufactory is 8,000,000 per day, or 48,000,000 per week, and 2,496,000,000 per annum. Well may it be asked "where all the pins go to?" The machine is perfect and simple in its operation. The wire is run into it from a reel, cut off the proper length, pointed, headed, and made a finished pin before it comes out again. From this machine they fall into the hopper of the sticking machine, in which they are arranged, stuck upon papers, and come out perfect, ready for packing for market. This last machine, tended by one girl, does the work of 30 persons by the old process. That is better than pauper labor. There are four other machines in the United States. These operating at the same rate, will make 312 pins per annum for every soul in the Union. There should be a large surplus for export to other countries, and at a profitable rate, after paying freight and charges, since no European machines can compete with this little contrivance.

## REFINED SUGAR.

The people of the United States are famous for having a "sweet tooth," and if the story about "pork and molasses" is not quite accurate, it is nevertheless true that a "little sweetening don't go far" in a family, or, to use a New York phrase, *into* a family. In the year 1870, the quantity of foreign sugar taken for consumption in the United States was 608,230 tons. The crop of Texas, Louisiana, and Florida, was 64,239 tons, making together 672,469 tons of cane sugar. The result was a total of 1,344,937,829 lbs., or about 34.9 lbs. per head. The amount of sugar imported in 1880 (all brown sugar except 15,654 lbs.) was 1,792,962,147 lbs., or a little more than 800,429 tons of 2,240 lbs. each, the import value of which was $78,853,466. The amount produced, including cane, sorghum, maple, and perhaps a small quantity of beet, and the sugar or glucose from corn, was about 325,000,000 lbs., making a grand total of 2,117,962,147 lbs. Nearly the whole of this was refined, and 29,065,376 lbs. were exported that year—about 14,533 tons. In 1879, the export was much larger, 58,431 tons, almost half of it going to Canada. The consumption of sugar alone in 1880 was 41.65 lbs. per head. The consumption of Great Britain is 36.25 lbs. per head; of France about 11 lbs., and of Germany still less. A generation grew up in the economical use of sugar, and even to this day in the rural districts, and among some of the old fogies of the cities, no other sugar is used than a piece of the sugar-baker's candy held in the mouth while the unsweetened liquid is drank. The story is told that this piece was formerly, in the times of privation during the war, suspended by a string from the ceiling over the table, and being taken in the mouth by one *convive* when drinking, was allowed to swing to that of her whose turn succeeded. The German idiomatic phrase of "*pass auf*" or "look out" for the next was said to have thus originated. In our own colonies the refiner was not by any means considered a necessary go-between of the cane and the consumer, who went directly to the fountain-head and used the molasses, or "long sugar," not only for his coffee, but to compound his new rum or "white-face" into "black-strap," with which he washed down his pumpkin pie, also sweetened with molasses; and few edibles escaped that sweetening, from a spoonful of brimstone in the spring to a mince pie at Christmas. Refined crept in, and with the use of this article various grades of pure sugars made their appearance. When the plants or canes are crushed in a mill, the juice flows abundantly through a strainer into the clarifier; where, mixed with alkali, which assists the operation, it is raised to a certain heat. It then passes through evaporating coppers, and the scum that arises in the process is removed. In the last copper it is boiled until it will granulate in the boiler. Here it soon ceases to be a liquid, and being placed in hogsheads with holes in their bottoms, the molasses drains out into a cistern below. When quite cured in this manner it is shipped as "brown" or "muscovado" sugar.

The next grade of sugar is "clayed;" when the sugar is properly boiled, it is poured into conical pots, apex down, with a hole in each. When the molasses has drained off, a stratum of moistened clay is spread over the surface, the moisture of which percolating through the mass contributes powerfully to its purification.

"Refined" sugar may be prepared by taking either the clayed or muscovado, redissolving it in water, and after boiling it with some purifying substance, as blood, or other articles, pour it into the conical pots again with the clay application.

The solutions of brown or clayed sugar, boiled until they become thick, and then removed into a hot room, form into crystals upon strings placed across the vessels, and become sugar-candy.

The use of molasses and brown sugar, as we have seen, is by far the most important in the United States. In the year 1857, when the Louisiana sugar crop failed, the importation of these articles reached nearly $57,000,000, and the import contributed principally to the panic of that year. Gradually the use of refined sugar has extended, and in 1850 the federal census reported 23 refineries, having a capital of $2,669,000, and using $7,662,685 worth of raw sugar, perhaps 70,000,000 lbs., and producing a value of $9,898,800. Since that period the business has greatly extended itself. In that year there were two in New York city, Woolsey's and Stuart's. These rapidly increased to fifteen, which together refined 200,000,000 lbs. of sugar, or about half what was produced in the whole United States. The introduction of machinery moved by steam almost revolutionized the business of refining. An important improvement that was made in substituting aluminous finings for bullock's blood, which was always productive of injurious consequences, greatly increased the production and raised the quality of sugar. The raw sugar of the Spanish West Indies and Brazil comes mostly in cases and boxes; that of New Orleans and the English islands in hogsheads; South America generally, Manilla, and the Mauritius send it in bags. When the refiner gets possession of any of these, he empties into a pan with a perforated bottom; through these perforations comes a current of steam which dissolves the sugar. Chemical application then bleaches the sugar or takes all its color from it. It then passes into the vacuum pans to be boiled by steam. The sugar in this process becomes so concentrated that it is held in solution only by the high temperature. The moment it begins to cool, a rapid crystallization takes place, producing the fine grain seen in loaf sugar. When the syrup has boiled sufficiently, it is poured into moulds which are prepared in the loaf form, for the purpose of facilitating the separation of the sugar. The liquor that runs from these moulds is subjected to a new boiling, when it yields lower grades of sugar. The syrup that exudes from this second process is sold as molasses, and the proportion of this is about 20 per cent. of the original quantity.

The art of refining has been carried to greater perfection in this country than in Europe, and so manifestly that no imported article can equal the fine granulated sugars of the domestic manufacturer. The business has spread with the demand for the improved sugars. The increase of the manufacture has also been aided by the federal government, which allows a drawback upon refined sugar exported equal to the duty on the equivalent raw sugar imported. The export of refined sugar in 1879 was 116,862,583 lbs., valued at $9,646,065, on which there was a drawback of $3,365,297.52. In 1880, the export had fallen to 29,065,376 lbs. (Canada, which had been our best customer, having through some change in tariff ceased to take our sugars except in very small quantity); the value of this sugar was $2,706,129, and the drawback $913,660.84. In 1881, there was a further reduction to 24,012,595 lbs., worth $2,356,669, on which the drawback was $758,048.66.

The consumption of molasses in the United States in 1880 was 45,299,184 gallons, of which 33,099,184 gallons were imported. The value of this was nearly $12,000,000.

"'New Process' sugar," says the report of the N. Y. Chamber of Commerce for 1881, "is an adulteration which has made its appearance within the past year, and is so largely sold that it deserves notice. It is made by taking yellow refined sugar and mixing it with about 25 per cent. of grape sugar or glucose. (This glucose is made from corn or potatoes by the use of sulphuric acid.) The color is thereby made white, resembling a coffee "A," but the saccharine properties are materially weakened. It is profitable to the seller, and difficult to distinguish from the pure article, but it is unprofitable to the consumer, and an adulteration which is as dishonest as it is undesirable." We may add that while this adulterated sugar has only about three-fifths of the sweetening power of the pure sugar, it is also objectionable as being the fruitful source of kidney and other diseases which are now so prevalent. Avoid "New Process" sugar as you would the small pox!

The sorghum sugar, of which we have spoken elsewhere, promises to be a product of great importance in the near future. "It has passed," says the N. Y. Chamber of Commerce report, "its experimental period, and the growth of a practical industry in its production may now be predicted. The best beet-root sugar, after many failures, is now succeeding in California and in Maine. About 4,500,000 lbs. were marketed in 1880. The sugars and syrups from both these sources are of excellent quality, and fully equal to the cane sugar and syrups in saccharine strength.

The refining of sugar is an immense industry, requiring large capital, and producing enormous values. Brooklyn, N. Y., is now probably most largely interested in it, though Philadelphia is not far behind, and San Francisco (which enjoys exceptional advantages in obtaining the Hawaiian raw sugars free of duty), Baltimore, St. Louis, Cincinnati, and New Orleans, and several points on the Hudson River, are largely engaged in it. The whole product considerably exceeds $150,000,000, and of this Brooklyn marketed in 1880 $59,711,168 in value. The manufacture of candies is of much importance in connection with the refining of sugar. The product is between $16,000,000 and $17,000,000, but the most shameless frauds are practiced by many manufacturers. *Terra alba*, or kaolin, a porcelain clay, and even inferior clays are much used, flour, plaster of Paris, and for the chocolate candies and caramels roasted peanuts, for flavors, fusel oil, and other artificial flavors, and for coloring many of the mineral poisons.

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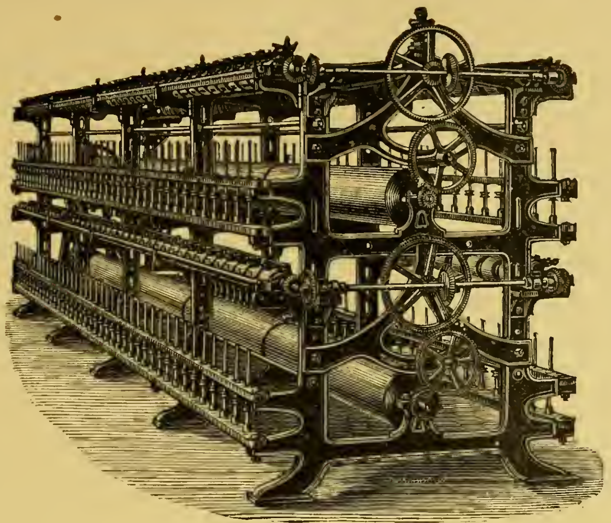
## SILK.

The culture and manufacture of silk are among the oldest industries of the colonies, and many efforts on the part of Congress and of enterprising men have been made to promote them, but the industry has not thriven in any degree to be compared with some of those that have grown steadily under the intelligent perseverance of unobtrusive individuals. No branch of industry is ever planted, promoted, or perfected by means of government operations alone. It must grow, if at all, out of the spontaneous promptings of individual genius, and live upon the necessities that give rise to it or the wants it of itself creates, to be healthily prosperous. Hence all the efforts that have been made to encourage the silk culture and manufacture have proved abortive, while individuals not encouraged have prosecuted branches of the trade not contemplated, with success. The southern colonies were early silk producers. So important had it become in 1753, that at a meeting of the imperial Board of Trade, Oct. 26, of that year, "the state of the colony of Georgia was taken into consideration, at a Board of Trade and Plantations, and it appeared that the colony produced upward of £17,000 [75,000 dollars] worth of *raw silk*, since January 1752, besides what is not yet come to the notice of the board." The other colonies of the South were also well engaged in it. Virginia in particular was largely interested in that industry. The culture of cotton and tobacco, however, in the early years of the Union, were so profitable as to absorb all other culture; and silk nearly disappeared, although numbers of farmers preserved their mulberry groves, and continue to make small quantities of raw silk. The state of Connecticut seems to have made the most decided efforts in that direction. The *New London Gazette* of 1768 informs us that William Hanks of Mansfield, had "raised silk enough for three women's gowns." The gowns of "three women" at the present day would involve a formidable amount of silk, but we are to presume he meant three "dresses" simply. The term gown, like "vandyke," seems to have become somewhat obsolete. Mr. William Hanks also advertised in the *Gazette*, 3,000 mulberry trees, three years old, and of one inch diameter. The best time to set them out, he says, is at the new moon of April. They were to be sold cheap, in order to promote the culture of silk. Sundry gentlemen in Windham had large mulberry orchards, intended to supply a silk factory erected at Lebanon. While all manufactures were in so depressed a state and struggling for life under the disability of deficient capital, it was hardly to be expected that so hazardous an undertaking as silk manufacture could make much progress. When, however, the high tariff policy after the war gave the spur to manufacturing of all kinds, that of silk was revived, mostly in Connecticut and Pennsylvania This had so progressed that in five small towns of the first-mentioned state, there were raised in 1829, 2½ tons of raw silk, valued at $21,188. In Washington, Pennsylvania, sewing silk was successfully produced, and some garments were made by individuals who performed the whole work, from the management of the worms to the weaving of the fabric. The town of Mansfield, Connecticut, was in that year the great seat of that industry. The population was 2,500, and produced as many pounds of silk. This silk was converted into the most beautiful sewing silk and some other manufactures by the skill and industry of that ingenious people. Thus prepared, the silk was at that time worth $8 per lb. This industry was carried on without interrupting the ordinary occupations of the people, and also employed the young and old not suited to the labors of the field. The mulberry trees are ornamental as shade trees, and do not impoverish the soil as much as fruit; and they will flourish in almost all latitudes, or wherever the apple will grow; and wherever they are present the silk-worm may be reared.

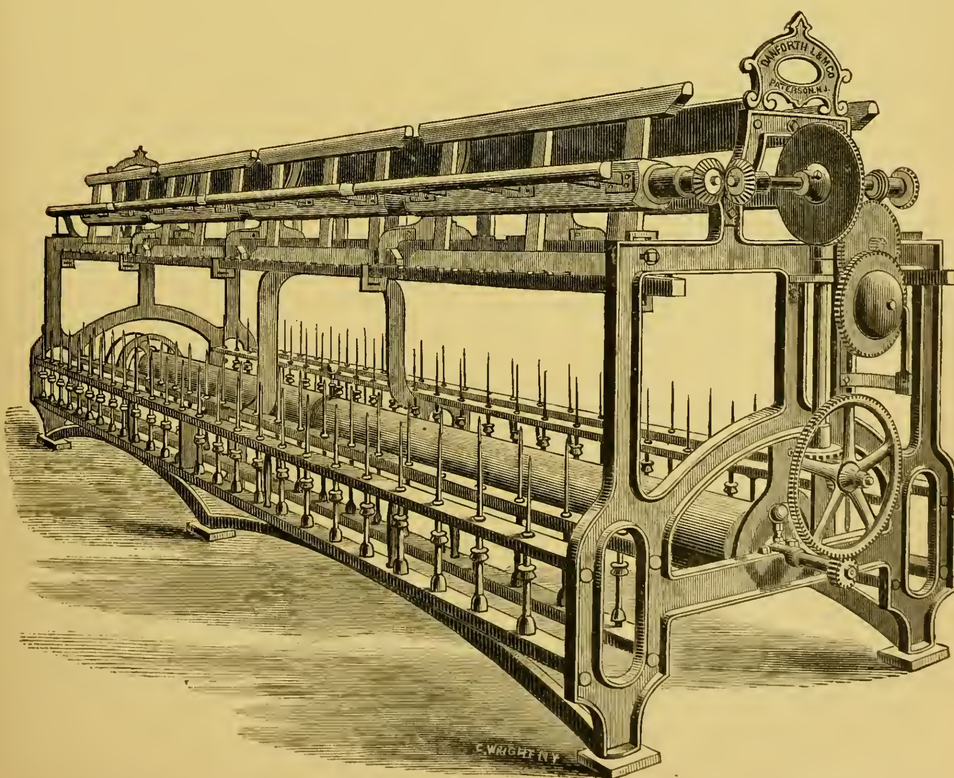
The feeding of the worms commences with the first opening of the mulberry leaf, and continues for the period of 32 days, when the worm commences its spinning, and ceases to eat. The leaves are gathered for the worms, and this gathering is the appropriate work of young children. Having wound itself in its cocoon, it requires nursing and watching, that the young may not eat its way out and by so doing destroy the silk. The cocoons being placed in warm water to soften the natural gum upon the silk, the winding is begun by women, one of whom can make 16 lbs. of raw silk in the season of six weeks.

The excellence of the silk depends upon the properties of the mulberry leaf, and these are considerably diversified. The white mulberry is decidedly the best, and of this there are several varieties. The kind to be cultivated and the mode of proceeding are to be learned from experience, which was very limited in the United States in 1829, when the attention of Congress was called to the silk culture by the petition of G. B. Clark, of the city of New York, for a grant of 262 acres of land owned by the United States, at Greenbush, New York, and used for military purposes, to aid him in rearing mulberry trees. The grant was made in the shape of a lease, on the condition that 100,000 mulberry trees should be planted, and that he should procure a sufficient number of worms to consume all the foliage that could be gathered from the trees. The culture never amounted to much, but the tax, 15 per cent., imposed upon imported raw silk in order to encourage the culture, was a great drawback upon the manufacture. Nevertheless, the excitement in relation to the mulberry trees progressed, and in the year 1831, the project of rearing silk-worms was renewed in various parts of the Union, with great vigor; and the subject not only attracted the attention of Congress, but bounties were offered by the legislatures of several States for all the raw silk produced within their limits for certain periods of time. The business soon began to be prosecuted with extreme ardor, and continued several years, resulting in the establishment of extensive nurseries of mulberry trees, but it ended with the downfall of the famous "Morus Multicaulis Speculation," in 1839. The rates of the mulberry cuttings were at 2 cents each in 1838. In that year, in the neighborhood of Hartford, Connecticut, many thousand trees were sold at 20 to 50 cents each. The trees were sent all over the country, and it was stated that the growth per acre gave from three to five thousand dollars. The demand for trees was from those who undertook, in all sections of the country, to plant mulberry groves for the supply of silk factories that were to be started. The sales of trees were often made on the ground, standing, at the rate of 12½ cents per foot, those "trees" not 12 inches high being rejected. That speculation was second only to the famous tulip mania of Holland, or the South Sea bubble of England, or the Mississippi scheme of France. The mulberry buds sold at fabulous prices, and passed rapidly from hand to hand of the speculators, till the bubble burst. The real evil, however, which the mania inflicted, was that the means taken to stimulate a doubtful culture retarded the manufacture of sewing silk and goods. In 1836, the state of Massachusetts paid $71 bounty on silk made in that year. This bounty rose to $2,111 in 1841. All the means used had raised the quantity of silk made in the United States in 1840, to 61,552 lbs., worth about $250,000. In 1844, the quantity was stated in the report of the commissioners of the United States census at 396,790 pounds, worth $1,400,000. In 1850, however, the quantity had fallen to 14,763 lbs., and in 1860 to 11,964 pounds. The effort to produce the silk failed, and retarded the silk manufacture, which had grown in England in some degree to rival France, where the silk is raised, by means of entire freedom from tax on the raw article.

In the year 1769, on the recommendation of Dr. Franklin through the American Philosophical Society, a filature of raw silk was established in Philadelphia, by private subscription, and placed under the direction of an intelligent and skillful Frenchman, who, it is said, produced samples of reeled silk not inferior in quality to the best from France and Italy. In 1771, the managers purchased 2,300 pounds of cocoons, all the product of Pennsylvania, New Jersey, and Delaware. The enterprise was interrupted by the Revolution. In 1819, five tons of raw silk were produced in Mansfield, Conn. In 1830, M. Hornerque attempted the silk manufacture in Philadelphia, and large quantities of cocoons were brought to him for sale, but for want of capital the enterprise failed. The production of silk and silk goods has been continuous in Mansfield, Conn., for more than fifty years. In 1841, the convicts in Auburn prison, New York, were employed in the manufacture of silk



SILK SPINNING FRAME.




SILK REED MILL. DANFORTH LOCOMOTIVE AND MACHINE WORKS, PATERSON, N. J.

for a time, with much success. In the first year a value of $12,762 was produced of sewing silk, pronounced superior to the imported article. The domestic supply of the raw article running short, the manufacture began more severely to feel the weight of the duty of 15 per cent. *ad valorem* on raw silk, and of 10 to 30 per cent. on dyestuffs. Many manufactories of ribbons grew in favor, and produced goods with a texture, finish, brilliancy of color, and general adaptability for an extended consumption that gave them advantage over the imported goods. In sewing silk, particularly, the American manufacturer has excelled. The American article is in every respect equal in color and finish to the imported, and superior in the spinning and "fixing the cord" (the great desideratum in this branch of manufacture) to the Neapolitan article.

Messrs. Cheney Brothers commenced the manufacture of silk goods at Manchester, and soon after at Hartford, Conn,, about 1840, and in 1870 were employing over 1,000 hands, and making 60,000 pounds of thrown silks, 60,000 pounds of "patent spun," 100,000 pieces of belt ribbons, and 600,000 yards of wide dress silks. They have also long held a very high rank as manufacturers of sewing silks. Paterson, N. J., is largely engaged in this manufacture, having 83 silk factories, some of them very large, and employing more than ten thousand operatives. At Hoboken, N. J., Schenectady, Troy, Yonkers, and New York city, the business is extensively carried on. The state of New York reported, in 1880, silk goods manufactured to the net value of $9,268,525, and New Jersey, $12,851,045. The total net value of silk goods manufactured in the United States had risen from $6,500,000 in 1860, to 34,-410,463 in 1880, of which all but $509,000 were produced in the five states of New Jersey, New York, Connecticut, Massachusetts, and Pennsylvania. The total imports of manufactured silk goods for the same year were $32,188.690. Making all allowance for undervaluation, the importation of manufactured silks did not exceed in real wholesale value $40,000,000; yet, owing to the general prosperity, the imports of 1880 were twenty-five per cent. more than in any previous year since 1873. The exports of manufactured silk amounted in the same year to $163,013. American sewing silk has not only driven imported sewings out of the market, but we are actually exporting it to Continental Europe. We manufacture two-thirds of our ribbons, the greater part of our satins, nearly all our handkerchiefs, trimmings, and passementeries, about one-third of our braids and bindings, one-fifth of our silk laces, and one-third of our dress goods, but no velvets, and not many mixed goods.

The attempts to produce raw silk here have not been very successful, not from the quality of the cocoons, which are of the very best, but from the difficulty of having it reeled cheaply and well. From 1830 to 1850, the importation of raw silk increased 300 per cent. The largest portion of the silk comes directly from China and Japan.

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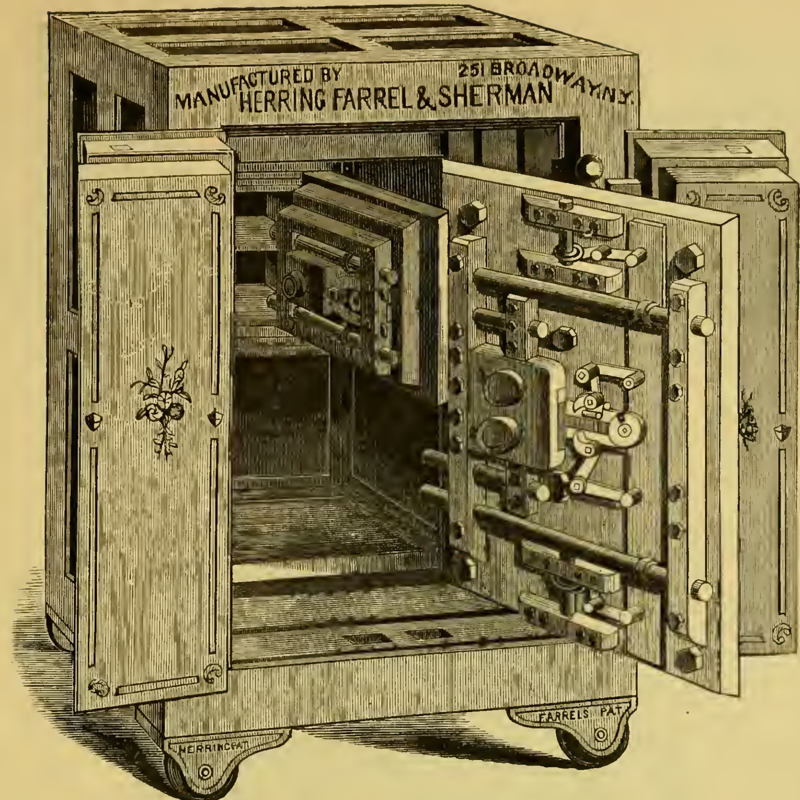
## FIRE-PROOF SAFES AND SAFE-LOCKS.

But a very few years have passed, since it was a matter of necessity for individuals to keep their valuables in their own houses, and to defend them from the attacks of burglars and the risks of fire, as they best could. For these purposes, strong boxes were in requisition. In modern times, paper promises have been substituted for the hard currency of former times, and banks become the depositories for that money, thus relieving individuals of the risk of keeping coin in their houses, to attract thieves. The banks are also depositories for plate and jewelry, and insurance companies guarantee from loss by fire. Under these circumstances, it was hardly to be anticipated that a demand for strong boxes should arise, when the use of them was apparently on the decline. Singularly enough, however, the art of making strong boxes has only been developed in the present century. It is to be considered, however, that with the progress of the credit system in the last 150 years, and the extension of commerce, paper securities and account-books of all kinds have multiplied, causing a greater demand than ever for iron chests. The manufacture of these, and of the locks to secure them, has taken great dimensions.

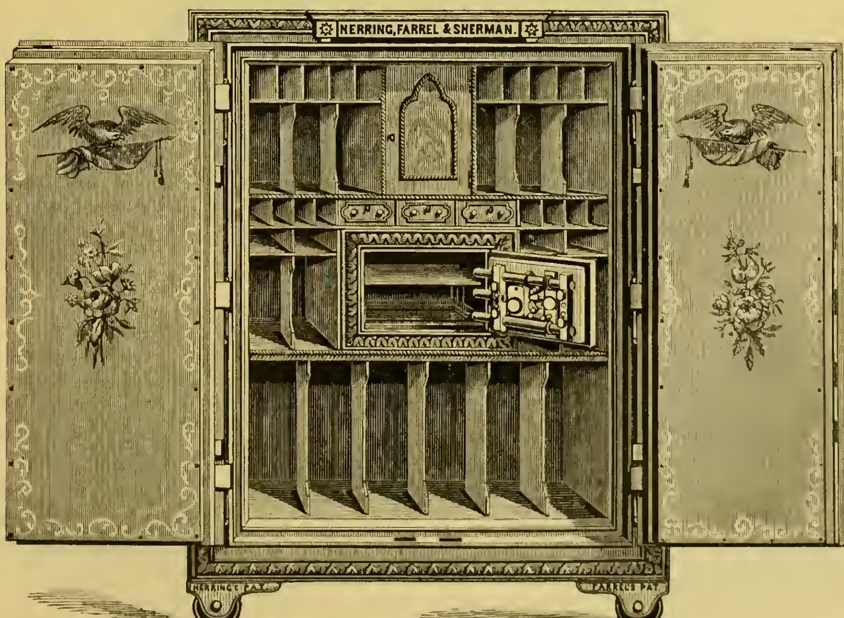
It is obvious that, in the construction of a chest, designed to be not only burglar but fire-proof, iron, as a material, would naturally suggest itself. Nevertheless, oak seems formerly to have been a favorite material, probably from the facility of working and ornamenting. An example of this kind of coffer is afforded in the chest in which the crown jewels of Scotland were deposited in 1707. The chest, beautifully ornamented, was secured with iron bands, hasps, and staples. There were three locks, which then, no doubt, afforded security, but each of them could be opened in five minutes with a bit of crooked wire in our day. At the close of the last century there began to be made the iron chests, known as "foreign coffers." These were constructed of sheet iron, strongly riveted to hoop iron, crossed at right angles on the outside. A lock throwing eight bolts inside, and two bars and staples for padlocks outside, were employed to secure the lid. Over the door lock was a cap beautifully pierced and chased, and a secretly operated escutcheon concealed the key-hole. These were formidable to look at, and no doubt answered their purpose all the better, that the science of lock-picking was then not so advanced as in the present day.

About the beginning of the present century, cast-iron chests began to be made for common purposes, and the manufacture flourished to a considerable extent. The idea of introducing non-conducting substances as a protection against fire, occurred but some years later. The favorite substance for this purpose is gypsum or plaster of Paris. This material was first used in Paris for the construction of fire-proof houses. The practice for more than fifty years had there been to erect hollow walls with spaces between them varying from five to nine inches in width. Plaster of Paris, mixed with water to a proper consistency, was poured into these spaces, where it set and became hard. After the beams and rafters were fixed in their places, boards were nailed to them, and the same material was spread thereon. The lower floors of the building were of plaster, over which tiles were laid. The same material was applied to fire-safes in Paris, and these were, to some extent, imported into New York about the year 1820. The first portable fire-proof chests introduced for sale in New York, were imported from France, by the late Joseph Boucheaud, Esq., about 1820, and no doubt many of our old merchants and bankers remember them, as many were sold for use in counting-houses and bank vaults. They were constructed of wood and iron; the foundation was a box of hard, close-grained wood, covered on the outside with plate iron, over which were hoops or bands of iron, about two inches wide, crossing each other at right angles, so forming squares on all sides of the chest. Holes were made in the bands and plates, through which well-made wrought-iron nails or spikes, having "*hollow*," half-spherical heads, were driven into and through the wooden box, and then "*clinched*." The inside of the chest was then lined with a covering of sheet iron. These chests had a well-finished but very large lock, having from six to eight bolts, operated by one turn of the key.

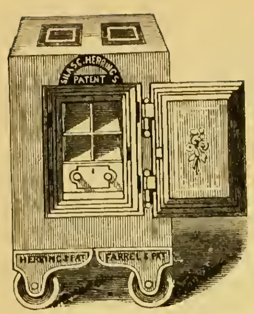
The first actual application of plaster of Paris to safes in this country seems to have been by James Conner, the type-founder, of New York. His business made him acquainted with the non-conducting qualities of plaster of Paris, and he applied it to an iron chest in his office, which chest has been in use ever since. Soon after, Jesse Delano, of New York, began making chests of the Paris pattern, substituting solid cast-iron heads, to secure the bands. In 1826, he patented an improvement, which consisted in coating the wooden foundation with a composition of equal parts, clay and lime, plumbago and mica, or saturating the wood in a solution of potash lye and alum, to render it incombustible. These were generally used in the country, and as a curious instance of the *fire-proof* qualities of these safes, we may state that one stood many years near the stove, in the counting-house of Lyman Stockbridge, of Hartford, until its fire-proof qualities seem to have been exhausted, since it spontaneously took fire and burnt up about 20 years since, without doing other injury on the premises. In this case, it would seem the fire-proof quality was inverted—viz., that the fire could not get *out*, instead of failing to get in. After Mr. Delano, C. J. Gayler began the safe manufacture, and in 1833 he patented his "double" fire-proof chest. This consisted of two chests, one so formed within the other as to have one or more spaces between them, to inclose air or any known non-conductors of heat. In the same year, one of these double chests was severely tested by being exposed in a large building in Thomaston, Maine, that was entirely destroyed by fire. The chest preserved its contents in good order. This excited the public admiration, and one enthusiastic writer described it as a "Salamander," which name has ever since been popularly applied to safes.



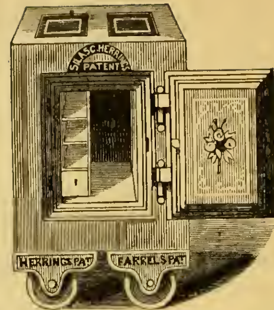

HERRING'S PATENT CHAMPION TRIPLE BANKER'S SAFE.



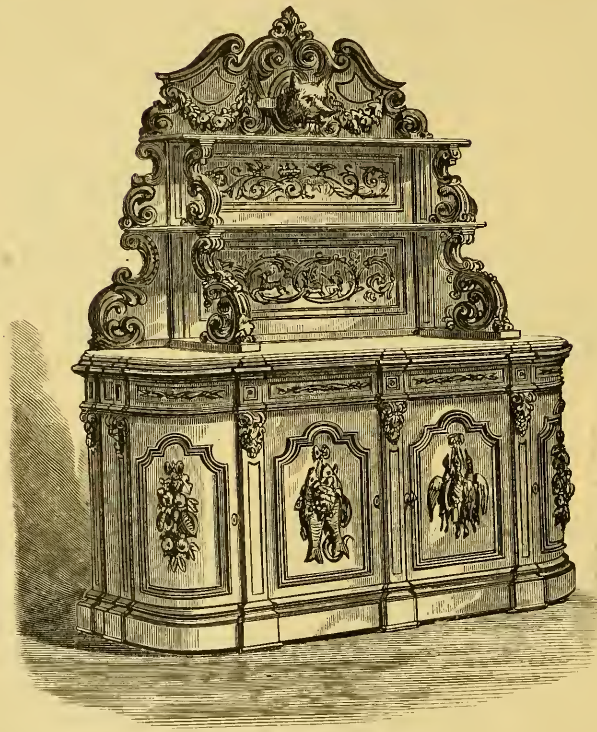

FIRE-PROOF SAFE, WITH INSIDE BANKER'S CHEST.



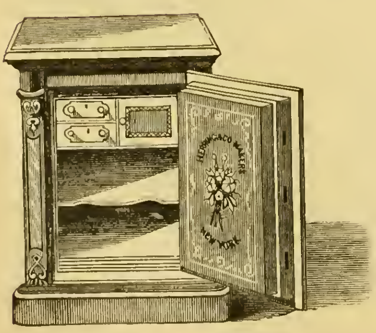
FIRE-PROOF SAFE.

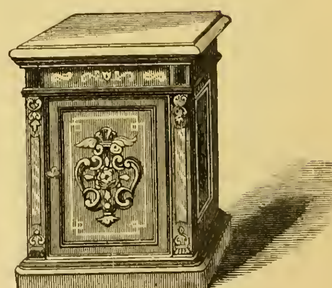
FIRE-PROOF SAFE.



BUFFET SIDEBOARD SAFE.



HOUSE SAFE, DOOR OPEN.



HOUSE SAFE, CLOSED.

The majority of the so-called "safes" in use at the time of the great fire in New York, in 1835, were simply iron closets, and were of little protection against the devouring element. There were then about sixty of Gayler's *double chests* in use, and a few of these preserved their contents. Soon after, John Scott obtained a patent for the use of asbestos for fire-proof chests. In 1837, Benjamin Sherwood obtained a patent for a revolving interior safe, filling the spaces with plaster of Paris and charcoal.

In 1843 Enos Wilder obtained a patent for the construction of a safe of heavy iron plates, filled with hydrated plaster of Paris, and soon after, Mr. Fitzgerald, whose discovery was made previously, was associated with him. About 1841, Mr. Silas C. Herring became interested in Wilder's safes, first as agent and afterwards as a manufacturer. The Wilder safes proved a protection against fires which destroyed the Gayler and other patents. In 1844, Enos Wilder's patent was transferred to his brother, B. G. Wilder, but the safes under this patent were made by Mr. Herring; and not long after, Messrs. Roberts & Rich commenced the manufacture on the same principles, but paid no royalty. After a protracted lawsuit, a compromise was effected by which both parties continued to manufacture. Other parties tried hydraulic cement, soapstone, alum and glue, alum alone, mica, asbestos, and other articles for filling, but none proved as effectual as the hydrated plaster of Paris, which, under the influence of intense heat, gave up its water of combination, and forming an atmosphere of steam in the inner portion of the safe, protected the books or papers from destruction. It was found, however, as early as 1854, that the plaster after a time gave up a part of its water of combination, made the interior of the safes mouldy and damp, and rusted the plates of iron till they were eaten through. Messrs. Herring & Co. had offered a reward of $1,000 for any filling which should stand the test better than the plaster which they were using. In 1852, Mr. Spear, a chemist of Philadelphia, discovered that the residuum of the soda fountains, after the liberation of carbonic acid gas for the so-called soda-water, possessed remarkable non-conducting powers. This residuum, which had been previously thrown away, was, by Spear's process, preserved, washed to free it from the sulphuric acid, which had acted upon the chalk, dried in a kiln, and when in a dry and almost impalpable powder, rammed into the safes. Messrs. Herring & Co. purchased Mr. Spear's discovery, and subsequently made an artificial *patented composition* for filling, consisting of whiting (*carbonate of lime*) prepared for use by a chemical process, and mixed with Epsom salt (*hydrated sulphate of magnesia*), carrying out Spear's principle with greater certainty. This was a dry powder, not deteriorating by age, not producing rust, and lighter in weight than other fillings. Mr. B. G. Wilder had meantime commenced the manufacture of safes under his patent, himself; and the successors of Messrs. Roberts & Rich, under several firm names, as Rich & Roff, Roff & Stearns, and Stearns & Marvin, also manufactured the Wilder safe. Next came a demand for burglar-proof safes. Lillie's safes were highly commended for this purpose, he using thick slabs of chilled cast-iron, and flowing cast-iron over wrought-iron ribs in their construction. It was found, after a time, however, that the burglars succeeded in drilling these sufficiently to blow them up in a few minutes, and that the dependence placed on them was not justified. Messrs. Herring & Co. a few years since adopted the plan of making their burglar-proof safes externally of boiler-plate wrought-iron, with inner layers of five plates of steel of different degrees of hardness, followed by a Franklinite plate, the hardest of all known metallic ores, over which was placed a wrought-iron basket-work, and iron and steel melted and cast over it, and all are secured together by conical bolts, which do not pass directly through the safe, and are irregularly placed. These were subjected to the severest possible test in 1879 by scientific experts, who worked continuously with the best helpers for almost twenty-six hours, used 125 drills, and could only penetrate 3.89 inches.

Among the burglar-proof locks, the Bramah, invented in England in 1784, was in high repute for many years, but was picked by Hobbs, a Boston locksmith, in 1851. A "permutation lock" was invented by Dr. Andrews, in 1841, and another by Newell, about 1843. Both were finally picked, and Newell then invented one with a detached tumbler, which was, after a time, picked by William Hall, of Boston, by the "smoke process," by which a smoky flame is introduced by the key-hole, and this leaves a fine deposit of lamp-black upon the "bellies" of the tumblers. When the key is next introduced, it removes the lamp-black from the parts it touches. By means of a small reflector, a strong light is then thrown in, bringing the key marks to view. The exact sizes for a false key are thus obtained. To prevent this operation, it was supposed that concealing the tumblers would be all that was requisite. H. C. Jones, of Newark, accomplished this by concentric rings and curtain; and Pyes did it more effectually with eccentric rings and curtain. The lock was now thought perfect. It was called the parautoptic (concealed from view) lock. A. C. Hobbs, with one of these at the English exhibition of 1851, defied the best English operators. One of these locks was used at the Bank of England, and they came into general use in the United States. In 1855, Linus Yale, jr., of Philadelphia, by means of the impression process, picked this great lock. In 1843, Linus Yale, senior, patented a "pin" lock and then the duplex lock, for which two keys are required. One being introduced, it was necessary to unscrew and remove its handle, then close the key-hole entirely with a hardened plate, before the other key-hole could open. The ingenuity of his son dispelled the idea that this was absolutely secure, by picking it. Yale, jr., being convinced that no lock is secure so long as the shape of the key prevents the entire closing of the hole, he set to work upon that principle, and in 1851 he invented the magic lock. In this lock, the key and its bits appear as of one piece; on being introduced into the lock, the bits are taken up by a pin, which enters through them into the centre of the key-shaft. The key then being turned in the usual manner, puts in motion a set of gear wheels. These first separate the bits from the key, and then carry them into the interior of the lock, away from the key-hole. They there operate upon the tumblers out of sight and beyond the reach of any picking tools. The same motion which carries away the bits effectually closes the key-hole. When the bolt is passed, the key-hole re-opens, the bits come back and join the handle to be taken out, as they were put in. The bits may be taken away in the pocket, if desired, leaving the handle with the lock. This mechanism seems to effect perfectly the conditions sought for security against picking. E. B. Denison, the famous clockmaker, of London, remarks in relation to this, as well as to Newell's, "that the casting of both these American locks (which have all their heavy parts of cast iron) is vastly superior to any iron castings we have ever seen made in England; and, on the whole, the United States are evidently far ahead of us in the manufacture of both good and cheap locks." This is certainly very gratifying praise to the national pride, when we reflect how few years since we depended entirely upon England for bank locks.

In the progress of the times, these locks have given place to those which are still better, and the efforts of the burglar have never been successful in either picking or forcing the Dexter combination locks. An additional safeguard has been that of the time-lock, which could not be opened, until the time for which it was set had expired.

Several new models of fire and burglar-proof safes have been patented within a few years past, but none of them seem to involve any new principle, and Herring's have thus far stood all tests with complete success.

## GLASS MANUFACTURE.

When we contemplate by turns each of the great materials most conducive to man's advancement in civilization, we are at times lost in the attempt to give precedence to any one, since so many have held so high a rank in the scale of usefulness. Iron has, perhaps, been the most important in respect of industrial purposes, and paper has been the means of recording and promoting that general intelligence without which progress could not be very extensive, but glass has entered more into the necessities of science, as well as those of social life and every-day comforts, than most materials. The great properties of glass are its transparency, its hardness, its power of assuming any possible form when hot, and its non-conductibility. Employed as windows, it transmits light into our dwellings while protecting us from the inclemency of the seasons and permitting a view of exterior objects; wrought into the form of vessels, it preserves all liquids without alteration, while we can inspect the contents. This quality, added to its indestructibility by any of the acids (except fluoric), has much facilitated the investigations of chemists. The physical sciences are not less indebted to it. It is the principal auxiliary of optics. With his glass prism, Newton decomposed light; it is by its means that astronomy makes its observations and discoveries in the infinity of space; combined in the microscope, it carries the vision of the naturalist into the most minute formations of nature; with it, those of short sight have the perception extended, and by it, the flattened vision of age is restored to its natural powers. To the science of fluids it is indispensable, and most of the experiments in caloric and electricity are due to its agency. If all the sciences are more or less dependent upon it, the ordinary usages of life are no less promoted by it. It gives mirrors for the toilet and for ornament to houses; it serves the table with liquids; it preserves works of art from the dust, ornaments lustres, and with it the precious stones can be imitated in all respects but in their hardness. In the arts its wonderfully varied powers may be put in requisition for almost all purposes, from the delicate spring of a chronometer watch to the heavy pipes for supplying water to cities. For the former purpose, its insensibility to climate and temperature gives it advantages over the metals used for that purpose.

The use of glass is of a very remote antiquity—how remote is left to conjecture. It had been supposed that the ancients were not acquainted with its use. Glass beads have, however, been found on mummies more than 3000 years old, and in the ruins of Nineveh bottles and vases have been found of glass; and the exhumations of Pompeii and Herculaneum disclosed the fact that it was in those cities used for windows, as well as for very numerous utensils, all of which gave evidence of great skill in glass work. The manufacture of glass spread from Italy to other countries of Europe, at first into Gaul. Bohemia was, however, possessed of the best materials in the greatest abundance, and the manufacture settled and acquired for Bohemian glass a reputation which has come down to our times for vessels. The use of glass for mirrors seems to have originated in Venice.

The manufacture of glass was carried on in England as early as 1439, according to Horace Walpole. Flint glass was made in London in the middle of the 16th century, and the manufacture of plate glass was commenced by the Duke of Buckingham, who imported Venetian workmen. Since then great progress has been made, and English flint glass has won a great reputation. The manufacture was one of the earliest introduced into the colonies. At Jamestown, Va., a glass-house was broken up by an irruption of Indians in 1632. There appears, however, to have been no accurate account of any until that of Mr. Hewes, of Boston, in Temple, N. H., 1780. Those works were operated by Hessians and Waldeckers, desertters from the British army; and one of the first articles there produced is now the property of Harvard University. Washington, in his diary, 1789, alludes to a glass-house in New Haven. In 1803 a German, of the name of Lint, undertook glassworks in Boston, and the state made him a bounty on every table of window glass made. From that time the works prospered, or at least were sustained.

The manufacture of crown glass was early commenced at Pittsburg, Pa., by Colonel O'Hara, who, in 1798, started glassworks in that city, to which the materials were brought from 30 to 100 miles' distance. The concern had a considerable success, and was followed by others until, in 1814, there were five glassworks at that place. In 1812, Messrs. Bakewell & Co. established at Pittsburg the first flint-glassworks in the Union. They brought the manufacture to great perfection, bringing out workmen from Europe at high wages. The style of cutting and engraving was thought equal to the foreign, and the operations of the house extended until the works became the largest for glass manufacture in the country. There were there made sets of glass for two Presidents of the United States; and a set of splendid vases there produced 40 years since, still adorns the saloon at La Grange, the seat of Lafayette. The house have also received the silver medal of the Franklin Institute. In other parts of the country the manufacture progressed to a greater or less extent, and in 1832 a committee of the New York convention made a report on the glass manufacture, from which it appears there were then in operation 21 glass furnaces, having 140 pots for the manufacture of crown glass; of these, 6 were at Boston. There were also in operation 23 for the manufacture of cylinder glass; of these, 10 were in Pennsylvania, 2 at Wheeling, 2 in Maryland, 2 in New York, 2 in Ohio, 1 in Massachusetts, 1 in New Hampshire, 1 in Vermont, 1 in Connecticut, and 1 in the District of Columbia. The whole value of flint glass then produced was given at $1,350,000. The most extensive green bottle factory was at that time Mr. Dyott's, near Philadelphia. There were there melted 4 tons per day, or 1,200 tons per annum. At that period the glass manufacture received an impulse, and in 1834 there were 6 works at Pittsburg, making crown and cylinder glass, green bottles, and apothecaries' phials. One bottle factory produced 1,600 dozen weekly, and a phial factory 2,200 gross weekly. There were also at Wheeling 2 crown and flint-glassworks, and 1 for phials and bottles. At Wellsburg, 16 miles distant, there were 1 flint glass and 1 green bottle factory.

The census of 1840 showed that there were then in the United States 81 glass-houses, employing 3,236 men. The aggregate capital was given at $2,014,100. Of these, 2 were in Virginia, 28 in Pennsylvania, 25 in New Jersey, 13 in New York, 2 in Vermont, 3 in Connecticut, 4 in Massachusetts, 3 in New Hampshire, and 1 in Michigan. The census did not distinguish the different branches of the glass manufacture, nor the modes of making window glass. In 1850 the number of works had risen to 94, with an aggregate capital of $3,402,350, employing 5,571 men, and producing a value of $4,641,676 per annum. In 1870 there were 166 establishments, with an aggregate capital of $10,866,382, employing 12,863 persons, paying $6,343,558 wages, using $4,732,408 of raw material, and producing $15,425,534 of glass. Of these establishments, 48 were in Pennsylvania, 52 in New York, 19 in Massachusetts, 10 in New Jersey (some of them very large), 10 in Ohio, 5 in Kentucky, 4 in Missouri, 3 each in Connecticut, Illinois, and Indiana, and 2 each in Maryland and California, and one each in Michigan, West Virginia, and District of Columbia. In 1865 there were 34 glass manufactories in New York, producing $1,664,000 worth of glass. In 1853 the first plate-glass manufactory in the U. S. was established at Cheshire, Mass. The hammered plate glass manufacture was established in 1856 in Philadelphia; also a new description, called "German flint," but better adapted for the use of apothecaries, chemists, perfumers, etc.

The materials for glass are several; the chief, silica, obtained from the sea beaches in the form of quartz sand, and from the quartz rocks of the interior. The name of "flint glass" came from the use of flints, calcined and ground to powder. This process is now supplanted by the use of sand, of which a fine article is imported into England from Austria. The purest used in the United States is obtained from Lanesborough, Mass., being a disintegrated quartz rock. This is used for the best flint and plate glass. Lime is used either in the form of pure limestone or quicklime. Potash is derived from common wood ashes, and the ashes of sea-plants supply soda. Pearlash is sometimes used; also the refined alkalies. Common salt and kryolite furnish carbonate of soda. In addition to these, saltpetre, alumina, and waste glass, enter into the ingredients of glass, the proportions of several kinds of which are as follows:—

English bottle glass—sand, 100 lbs.; lixiviated ashes, 100; wood ashes, 40; kelp, 40; clay, 80; cullet, or waste glass, 100. For Bohemian crystal, are used—100 lbs. sand; purified potash, 60; chalk, 8; cullet and manganese, 40. In window glass are used—100 lbs. sand; chalk, 40; carbonate of soda, 35; of broken glass, from 60 to 180; and some manganese and arsenic. For plate glass—Lynn sand, washed and dried, 720 lbs; alkaline salt, of which 40 per cent. is soda, 450 lbs.; lime, 80; nitre, 25; broken plate glass, 425. These will give 1,200 lbs. of glass. For Faraday's heavy optical glass—protoxide of lead, 140 lbs.; silicate of lead, 24; dry boracic acid, 25; and 100 lbs. of sand. Artificial gems are composed of 100 lbs. of quartz crystal, or sand; pure minium, or red lead, 154 lbs.; caustic potash, 54 lbs.; boracic acid, 7; and some arsenious acid.

The introduction into this country of the kryolite (a natural double fluoride of aluminium and sodium found in large quantity only at Ivigtut, in the southeastern extremity of Greenland), has led to considerable changes in the manufacture of glass, of which carbonate of soda and soda ash, produced most cheaply from the kryolite, are important ingredients. Nearly 3,000 tons of the kryolite are also consumed annually in the manufacture of hot cast porcelain, a species of opaque glass which is fast taking the place of glass, porcelain, and bisque, for many uses, as well as tiling for floors, from its superior beauty and cheapness. The American Hot Cast Porcelain Co., and the Atlantic Quartz Co., both of Philadelphia, are engaged in this manufacture.

Bituminous coal, coke, or seasoned wood, may be used for fuel, though wood is generally preferred. In some glassworks of the

United States, rosin is preferred to all other fuel, since when pulverized it may be added in small quantities at a time. It burns without giving off impurities that may mix with or injure the glass, and it leaves no residuum.

In proceeding to manufacture, when the combination of materials is formed, they are thoroughly ground, mixed together, and sifted. The glass furnace is a large circular dome, in the centre of which is the fire. This is surrounded by 8 to 12 melting pots, which being raised to a white heat, receive the mixed glass in quantities about one eighth at a time. As each instalment melts down, the others are added. The entire quantity being melted, the fires are urged to the utmost, while the workmen watch the operation, with long iron rods, by means of which they extract from the boiling mass portions, from time to time, until transparency, on cooling, indicates that perfect fusion of all the materials has taken place. A scum rises during the boiling which is removed as it appears. The heat is then raised to the highest degree, to perfect the fusion. The glass is now made, but it contains many impurities, being substances that would not melt; and there is also still a quantity of gas, which, if not got rid of, will form those bubbles that are sometimes seen in common window glass. The mass is therefore kept fluid for about 48 hours, by which means the "metal" is fined, that is, all the bubbles of gas will have disappeared, and insoluble matters will have settled to the bottom. The heat is then allowed to subside until the metal becomes thick enough to work, at which point the temperature is maintained in order to keep the glass in this condition. The pots that surround the furnace will generally thus hold enough to employ the force day and night for the first four days of the week, the hands being divided into gangs that relieve each other every six hours.

The glass materials, being thus brought into suitable combination, are ready for some of the numerous branches of manipulation in which that article is employed—the manufacture of window glass, plate glass, bottles, phials, flint glass, vessels of all descriptions, gems, optical instruments, etc. The manufacture of window glass is perhaps the most extensive, and this is conducted in two modes. By one the glass is blown into "tables," like cart wheels, and by the other it is formed into cylinders, that are cut open lengthwise and flattened out. The former is the more generally practised. That description is generally known as English crown glass. In the manufacture, the melting pots, of which there are usually eight, hold about half a ton of metal each, and this will suffice for 100 tables of crown glass. When the glass is in its proper state, the workman is armed with a pipe, or blowing tube, 4 or 5 feet long, with a bore $\frac{1}{4}$ to 1 inch in diameter, and a little larger at the mouth end than at the other. It is, as it were, a long hand, with which, the end being heated red hot, the workman reaches into the pot of melted matter, and gathers up the quantity he requires. By long experience he is enabled to do this with great exactness, and this, for crown glass, will not vary much from 9 lbs. The pipe being cooled to admit of handling, the lump is rolled upon the *marver* (which is a polished cast-iron slab), to give it a conical form. Blowing through the tube, at the same time, causes the lump to swell. It is then heated in the furnace, and again rolled and enlarged by blowing. In this operation, the portion next the tube becomes hollow, and the greater portion of the glass works toward the point of the cone it forms in rolling. The solid point is called the bullion. This being softened in the furnace, the tube is laid across a rest, and made to revolve, while the glass is blown to a globe. During this operation, a boy supports the soft end, or bullion, with an iron rod. The globe, by continually revolving, increases in size, and flattens out, the bullion point still forming a thick centre, to which an iron rod, called a pontil, which has a little molten glass on its end, is applied; at the same moment the globe being separated from the blow pipe by the application of a piece of cold iron to its "nose," remains upon the pontil. As the tube breaks away, it leaves a circular opening, which the workman, holding by the pontil, presents to the furnace. By this means it is softened almost to melting, and being made to revolve rapidly, the opening grows rapidly larger by centrifugal force. The heated air in the globe prevents the two opposite faces from coming together. The portion next the fire appears to roll inside out, and it suddenly, with a noise like opening a wet umbrella, flattens out into a circular disk, which is then removed from the fire, and kept revolving until it is cold. The pontil is then cracked off, and the disk removed to the annealing oven, and set up on edge with the rest, arranged in rows, and supported by iron rods, so as not to press against each other. The annealing is completed in 24 to 48 hours. These "tables" are generally 52 inches in diameter; sometimes, however, as much as 70 inches.

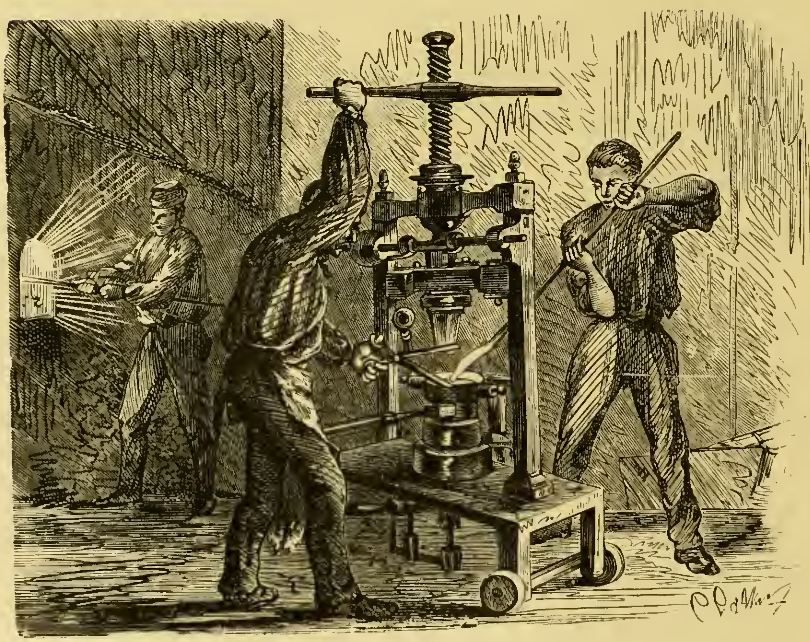
Plate glass imperfectly annealed will, when once cracked, soon fall all to pieces. The annealing process is simply to place the hot glass in a hot oven, and allow the whole to cool gradually. By this operation it is found that glass is deprived of much of its brittleness. The explanation is, that the glass is a non-conductor, and when made, the exterior cools first, forming a crystalline crust which shelters the interior particles, so that these continue longer in the fluid state, and are prevented from expanding as glass usually does when it cools. The interior has thus a constant tendency to expand or burst out. When the whole is allowed to cool slowly in an oven, all the fibres of the glass assume their proper and natural places, and the mass becomes tough and elastic. The effect of sudden cooling is manifest in the toys called "Prince Rupert's drops." These are simply hot glass dropped into water. In so doing, most of the drops burst to pieces, but some retain a pear shape. These, when taken out, will bear a smart blow without breaking; but the smallest break at the stem will cause the whole to fly to pieces with a loud explosion. Bologna phials are formed of unannealed glass 4 or 5 inches long, and ½ inch thick. These will bear a hard blow, or a bullet may be safely dropped in. If, however, a sharp fragment of sand is introduced, the phial will fly to pieces. Annealing deprives them of these qualities.

From the annealing kiln the tables go to the warehouse, and are there assorted according to defects and qualities. Each one is then laid in turn upon a "nest" or cushion, and is divided by a diamond into two pieces, one of which, the larger, contains the bull's eye. These are then cut into square panes. The circular shape and the bull's eye involve much waste in cutting. The glass thus manufactured, however, has a remarkable brilliancy, and for that reason it is preferred to the cylinder process, by which, however, larger panes are made.

The cylinder process has been pursued to a great extent in the United States. It is practised by a number of workmen. Sometimes 10 are arranged side by side, with a raised platform extended in front of the furnaces 10 feet above the bottom. Standing upon this, each man gathers a proper quantity of metal from the pot before him. By applying the lump to a wooden mould and blowing, it takes a globe form. This he heats, and then holds upon the pipe vertically over his head, at the same time blowing into it. This causes the globe to flatten. It is then held down so as to swing below the platform on which the worker stands. This, with continued blowing, causes the glass to elongate in the form of a cylinder. The workman watches with care lest the elongation should proceed too rapidly, in which case he raises it again over his head. This operation is dexterously continued until the cylinder attains 47 inches in length, and 10 inches in diameter. The end is then softened in the fire, while the pipe is closed with the thumb. The air within the cylinder then expands so as to burst out the end. The edges of the opening thus caused are then spread and trimmed. The tube end is cut off when the glass is cool by the application of a hot iron, and letting fall a drop of water on the heated line. The cylinder is now to be cut open lengthwise in order that it may be flattened out into a pane. For this purpose two methods may be employed —one with the hot iron and cold water, and the other by a diamond applied inside the cylinder along a rule. The cylinders are now carried to the flattening furnace, where they are laid, slit uppermost, on the flattening stone. Here, as they soften, they open out, and a workman with an iron rod aids the operation. Another at the same time, with a rod having a block of wood at the end for polishing the sheets, works down the irregularities of the surface. The sheet is then passed into the annealing oven. In every stage of this process, the sheets are exposed to imperfections, and, in consequence, few are perfect. Most answer for inferior uses. None have the brilliancy of crown glass. The main difficulty is in the wrinkling. The glass being made in the cylinder form, the inner and outer surfaces are of unequal lengths. In the flattening out, this inequality produces undulations, called cockles, which distort objects seen through the glass. The unevenness also made it very troublesome to polish the surface until the difficulty was overcome by the device of pressing upon each sheet soft leather, which, acting like a boy's "sucker,"

MANUFACTURE OF GLASS BOTTLES.

GOBLET MAKERS.



PRESS FOR MOLDING GOBLETS.

MANUFACTURE OF WINDOW GLASS.

adheres to the glass by atmospheric pressure. Two plates thus held are laid face to face, and, by the action of machinery, rapidly rubbed together with the intervention of polishing sand and water. By this means a beautiful polish is bestowed.

By these two methods of manufacture most of the glass used in the United States is produced. For the ten years 1871–80, the annual importation of glass has averaged $5,012,032; of this, about one-third has been plate glass. The average export for the same period has been about $660,000.

Various causes affect the combination and the qualities of the compounds. The alkali in window glass, powdered and moistened, is detected by its action upon turmeric paper, and may be dissolved out by boiling water. Atmospheric agents sometimes remove it in part from window panes, leaving a film of silicate of lime. The glass of stable windows is liable to change its appearance and assume prismatic colors from the action of the ammoniacal vapors upon the silica. When moderately heated, glass is readily broken in any direction by the sudden contraction produced by the prompt application of a cold body to its surface. It may be bored with a steel drill kept slightly moistened with water, which forms a paste with the powder produced. Copper tubes, fed with emery, also serve to bore holes in glass.

As very large panes of glass could be made by neither of the above methods, the large plate glass used for mirrors and for shop windows is cast. The mixtures employed do not vary much from those used in sheet glass. A larger proportion of soda is used; but this pushed to excess gives a greenish tinge. The greatest care is taken in the selection of the materials. When the glass is melted in the pots, it is ladled into cisterns or *cuvettes* placed in the fire by the side of the pots. Some manufacturers allow the metal to remain fluid in the pots sixteen hours, and an equal time in the *cuvettes;* and in some cases, in order to allow the soda to volatilize and the air-bubbles to escape, the time is prolonged to forty-eight hours. When nearly ready, the temperature of the glass is allowed to fall in order that the material may assume a pasty consistency. Meantime the casting-plate is prepared. This is usually a cast-iron plate, perhaps seven inches thick, eleven feet broad, and twenty feet long.



It has raised edges to prevent the glass from flowing off, of a depth proportioned to the proposed thickness of the glass plate. On a level with this table, and arranged along its side, are the annealing ovens. Each of these is sixteen feet wide and forty feet deep. Hot coals are heaped upon the plate to bring it to a proper temperature. The cistern swung on a crane is then approached to the table, which is thoroughly cleaned, and the melted glass carefully skimmed with a copper blade. By canting the cistern, the glass is then poured upon the table. A copper cylinder, three feet in diameter, extends across the table, resting on the raised edges. This, being rolled forward, sweeps before it the excess of glass, spreading the whole uniformly of a thickness governed by the raised edges of the table. The effect of the passage of the copper roller upon the brilliant surface of the glass is very beautiful, leaving, as it does, a splendid play of colors. The superfluous glass being then trimmed from the edges, the plate is thrust forward into the annealing oven, previously raised to a red heat. Successive plates are thus cast until the annealing oven is full, when it is closed up and left five days to cool. When taken from the oven the plates are examined for defects, and the mode of cutting decided upon is then done with a diamond.

The invention of the sand-blast by Tilghman, of Philadelphia, and its wonderful adaptation for carving, etching, engraving, and drilling glass has added greatly to the economical uses of glass. It is equally well adapted to cutting, etching, carving, and boring plate and blown glass, and by its use any design made in paper, lace, or other material composed of vegetable fiber may be worked out in a few moments with the utmost perfection. As a consequence, plate glass one-fourth to one-half an inch in thickness is used for small shelves at the teller's, cashier's, and bookkeeper's desks in banks, insurance offices, and stores, in hand-mirrors, parlor summer pieces, for the sides of fine clocks, and the covering of the dial plates, for furniture, library doors, the floors of vestibules, etc., etc.

There are many modes of grinding and polishing, but in this, as in most other arts, the latest improvement is an American invention, which, highly successful here, was introduced into England in 1856. A circular plate of cast-iron, 10 feet in diameter and

2 inches thick, is secured upon the upper end of a vertical shaft, so as to revolve with it. Above the table, frames are arranged to hold the plates of glass, which are laid in a bed of plaster of Paris, with the face to be polished resting upon the revolving table. The frames are so arranged that the friction of the table upon the glass causes them to revolve so as to present every portion of the glass surface to an equal amount of rubbing. When sand is required to grind down the glass, it is fed in from a box above the frame. This is found to be the best mode; but sometimes the surfaces of the plates are ground together. After grinding, they are smoothed with emery powders of successive fineness until they are ready for polishing. This, in the American machinery, is performed by rings coated with felt and screwed to the surface of the iron table. Oxide of iron or rouge is applied to the felt as a polishing agency. When this is completed they are ready for silvering.

In the process of silvering, a large stone table is prepared so as to be canted, by means of a screw beneath it, on one side. Around the edges of the table is a groove, in which quicksilver may flow, and drop from one corner into bowls placed to receive it. The table, being made perfectly horizontal, is covered with tin foil carefully laid over it. A strip of glass is placed along each of three sides of the foil to prevent the mercury from flowing off. The metal is then with ladles poured upon the foil until it is a quarter of an inch deep, and its tendency to flow is checked by its affinity for the tin foil. The plate of glass, well cleaned, is dexterously slidden on from the open side. Its advancing edge is carefully kept in the quicksilver, so that no air or any impurities can get between the metal and the glass. When exactly in its place it is held until one edge of the table is raised 10 or 15 degrees, and the superfluous metal has run off. Heavy weights are then placed on the glass, and it is so left several hours. It is then turned over, and placed upon a frame, the metal uppermost, which becomes hard in the course of several weeks. Patents have been taken out for precipitating silver upon the glass, but this process is not so successful as the old.

When these plates are used for shop windows, some of them require to be bent in various manners. This is a separate branch of business, and is carried on at Newark, N. J., extensively. The bed is made of suitable material, on the floor of the furnace, and made in the required form. The sheet of glass is laid upon this, and as it softens in the heat, it assumes the form of the bed on which it is laid.

The manufacture of flint glass for domestic purposes requires great care in the selection of the materials. It possesses the properties of great transparency and high refractive power. Its brilliancy and density are in some degree due to the introduction of oxide of lead. Oxide of zinc has also been found effective for the same purpose. In order to protect the glass from effects of smoke or other elements which might discolor it, it is melted in a covered pot, with an opening in a short neck on one side. The heat is made very intense that the fusion may be rapid. The moment fusion and fining have thoroughly taken place, the heat is reduced, to prevent the deleterious action of the materials of the vessel upon the glass. In the United States, when the metal is taken out by the workmen, it is shaped in the required form by pressing into a die. For this purpose, when the article is large, considerable pressure is required. The experience and skill of the workman are put to the test in taking up just the quantity of metal required to fill the mould, which is kept at a red heat. The objects, being formed, go through the cutting process, as it is called, but really the grinding process. Circular stones or metallic disks are made to revolve, being fed with sand and water for coarse grinding, and emery for finer work. The marks left in the coarse grinding are removed by application to wooden revolving wheels, fed with pumice or rotten-stone, and finally with putty powder, a preparation of tin and lead. The fine polishing of chandelier drops, and similar ornaments, is effected by a lead wheel, supplied with rotten-stone and water. Globes and lamp shades are polished on the inside by filling them with sand, and placing them in a drum, which revolves rapidly for a length of time.

The glass most important in the arts is certainly that used for optical instruments. Flint and crown glass are both used for that purpose, but both have their defects. Those of the former arise from the difficulty of effecting uniform fusion, and crown glass is seldom possessed of the requisite uniformity of texture. These difficulties were so great that, until the early part of the present century lenses larger than three and a half inches could not be made. At that time a Swiss clockmaker, Guinand, produced them as large as nine inches, of the greatest perfection. The secret remained with him for a long time, but was finally, by one of his sons, imparted to M. Bontemps, who, in 1828, produced lenses of twelve to fourteen inches. The secret was in keeping the mixture actively stirred when liquid, and then suffering it to cool and anneal in the pot. Lenses are now made of flint glass twenty-nine inches in diameter, and weighing two cwt.

The production of vessels of colored glass is conducted in a very ingenious manner. The coloring matters are various. Blue transparent glass is made with two lbs. oxide of cobalt; azure blue, four lbs. oxide of copper; ruby red, four oz. oxide of gold; other colors by various combinations. Sometimes the color is incorporated merely with the outer portion of the glass. This is effected in the blowing by dipping the lump of clear glass, when shaped upon the marver, into the pot of melted colored glass, and then blowing it to the shape required, and flashing out, if desired to convert it into panes. The color may afterwards be reduced in depth by grinding, and clear spots reached by grinding through the color. In the process of "casing," a portion of partially-blown flint glass is inserted into a thin shell of colored glass, and then blown until it fills the shell, with which it becomes incorporated by heating and further blowing; casings of different colors may be thus applied. In painting, the color, mixed with a flux that will fuse at a lower temperature than the glass, and with boiled oil, is laid on with a brush as in ordinary painting, or by blocks, as in calico printing. The glass is then heated, when the flux melts and sinks into the body. The painting of glass for church windows was formerly carried to a high degree of excellence that moderns have not been able to equal. Although the recipes have been preserved in ancient treatises, the process has been lost.

Enameled glass has been much used for the last thirty or forty years. In this process the enamel substance (which consists of silica, soda, and oxide of lead, made opaque by oxide of tin or antimony) is ground to an impalpable powder, and then laid with a brush, in a pasty state, upon the glass. After the paste is dried, the ornament is etched out either by hand or by machinery. The glass being then softened in the intense heat of the furnace, the enamel becomes vitrified and incorporated with it. It then passes to the annealing furnace. This process was invented by Mr. William Cooper, of the firm of Cooper & Belcher, New York, whose extensive works at Newark, N. J., supplied 60,000 feet for the New York Crystal Palace. Another variety, the flocked, has now come more into use. The process is nearly the same, except that a smooth opaque surface is given to the glass before the enamel is applied.

Pittsburgh and its sister city, Alleghany, are more largely engaged in the manufacture of glass than any other city or town in the United States. Window glass of all descriptions is made here in vast quantities; plate glass, though not of the highest quality, all descriptions of glass for table ware, their pressed glass being so perfect that even experts are deceived and mistake it for cut glass, and all descriptions of glass ornaments, stained, colored, and enameled glass. Two or three descriptions of glassware are, however, made in greater perfection in Belleville, New Jersey, and the other glass works of Messrs. Whitall, Tatum & Co., than anywhere else in this country or Europe. In their two manufactories, which are said to be the largest glass works in the world, they produce druggists' bottles and vials which are superior to any others, and are largely in demand in England and France. They also make the best glass jars for canning purposes, and most bottles for mineral waters, etc. Brooklyn, N. Y., is also extensively engaged in the glass manufacture.

Soluble glass has been made of later years of equal parts silica and caustic potash. This is soluble in boiling water, and is used extensively for making buildings and all combustible bodies fire-proof.

In the manufacture of bottles, the metal, on being withdrawn from the melting pot on the end of the blowing tube, is, if for common black bottles, shaped in concavities that are made in the edge of the marver. Fine bottles of flint glass are shaped in moulds of brass or iron, which are made in two parts hinged together, so that they may be opened and shut with the foot. Bottles for champagne, soda-water, etc., are made of extraordinary strength, and tested before using by hydraulic pressure. They ought to support, for this purpose, a pressure of forty atmospheres, or 600 lbs. on the square inch. Notwithstanding the great strength with which they are usually made, the breakage in the manufacture of champagne bottles is rated at 30 per cent.

The glass is drawn out into tubes in a manner that illustrates the curious manipulations of the metal. The workman, with his blowing tube, accumulates a certain quantity by successive dips into the melting pot. This is then blown into a globe. Another workman then takes hold with a pontil, at a point exactly opposite the blowing tube. The two men then separate, and the globe contracts in the middle, which being drawn out to the size of the tube desired cools, and the hotter portions successively yield to the drawing, until a tube of 100 feet or more hangs between the workmen. The diameter of the bore retains its proportion to the thickness of the glass; hence thin tubes must be drawn from globes blown to a large size. These tubes of colored glass may be converted into beads. Beads have always been a great element in the trade with the North American Indians, being highly prized by them.

Within the last decade (1870–1880) several manufacturers have produced toughened, or as it is sometimes (though incorrectly) called "indestructible glass." As at first made, it was produced by cooling the external surface rapidly, on the same principle as the "Rupert's drops," but it was found that glass toughened in this way, while it would stand very rough handling, would, if struck by a sharp point so as to puncture in the slightest degree this external coat, fly at once into a thousand pieces, and often imperil the eyesight or the life of a person holding it. A better method, and one which rendered the glass very tough, was annealing it in heated oil. By this process, glass, formerly the most fragile of wares, is now rendered almost as durable as metal.

## INDIA-RUBBER AND ITS MANUFACTURE.

One of the most remarkable American discoveries of the present century is, undoubtedly, the mode of manufacturing and applying the article known to commerce as "India-rubber," but which, among the people of South America, is called "caoutchouc." The article in question is a gum procured from a peculiar tree in the hottest regions of the equator. The tree which yields this gum in the East Indies is somewhat different from that which produces it in the equatorial regions of South America. The former ("ficus elastica") is represented in an engraving on another page. Although the gum was used in a rude fashion since many ages by the inhabitants of the countries which produce it (and it had been known to commerce for a long time, having been discovered by a French philosopher in 1736), it is only within 20 years that its value has been appreciated. In that time, under the genius of American manufacturers, it has risen to a rank equal, perhaps, to that of iron and glass among the materials that administer to the necessities and comforts of man.

In the forests of equatorial South America the "siphonia elastica" grows to a height of 60 or 70 feet, and is covered with a scaly bark. It bears a fruit, which encloses a white almond highly esteemed by the natives. A slight wound on this tree causes the sap to flow freely, thick, white, and unctuous, like the sap of the milk-weed. On being exposed to the air, this soon becomes solid. This sap is collected by the natives, who make a longitudinal cut in the centre of the tree, and lateral cuts leading diagonally into it. At the bottom of the perpendicular cut a banana leaf is placed to conduct the sap, as it flows, into a vessel placed to receive it. The sap is used for the formation of bottles, boots, shoes, and various articles. The process is to form the figure of the thing desired in clay, and cover it on the outside with many coats of the gum, exposing it to fire to dry. When the desired thickness is obtained, the mould is soaked out in water, and the article is ready for use. Clumsy shoes, rudely fashioned in this manner, were long an article of importation from Para into the United States, and extensively sold down to within 20 years. There was little other use made of the article except to erase pencil marks, and for which purpose was charged 50 cents for ½ a cubic inch. The nature of the gum did not, however, long fail to become an object of research. The learned decided that it was neither gum nor resin, but of a peculiar nature analogous to resin, from which it differed in not being soluble in alcohol. Many attempts to make it useful in the arts were made, and finally it was found that by dissolving it in volatile oil there was obtained a sort of varnish very useful in making certain tissues and fabrics water-proof. A thin coat, placed between two sheets of stuff, caused them to adhere closely and made them impervious as well to water as to air. This application of it was made in the manufacture of mattresses, cushions, pillows, boots, bottles, etc. A solution in linseed oil is called an excellent varnish for making leather water-tight. The best solvents are said, however, to be oil of turpentine, coal, naphtha, and benzole. Alcohol will not dissolve it, but will precipitate it from ether. Another solvent is of rubber itself, called caoutchoucin. It is produced by exposing rubber to a heat of 600°, when it goes off in a vapor, which, being condensed, produces the solvent. All these applications, however, utilized only one of the distinguishing properties of rubber, viz., its imperviousness to water. An inventor, however, by the aid of a new solvent, found means to spin threads of the rubber of various degrees of fineness and strength. These threads, covered with textile fabrics—silk, wool, cotton, or linen—became light and supple tissues of extraordinary elasticity. This opened the way to an immense number of employments.

In some machines the rubber is kneaded, and compressed in various ways, and finally a number of the balls thus treated are brought together and powerfully squeezed by a screw press in cast-iron moulds, in which, being firmly secured, the mass is left several days. This process is somewhat modified in different establishments. In some, the cleaned shreds are rolled into sheets, from which threads and thin rubber are sliced by the application of suitable knives, worked by machines, and kept wet. The sheets are at once ready for the purpose to which this form is applied, or, by machinery of great ingenuity, they are cut into long threads of any desired degree of fineness. If then required to be joined, a clean oblique cut is made, with a pair of scissors, and the parts being brought together, readily and perfectly unite by the pressure of the fingers. As the threads are reeled off, they are elongated about eight times their original length by passing through the hands of a boy, and by the same operation they are deprived of their elasticity. After remaining on the reel some days, they are wound upon bobbins, and are then ready for weaving and braiding. The threads are of different fineness. A pound of caoutchouc can, by one machine, be made into 8000 yards of thread. This may, by another, be divided by 4, making 32,000 yards. Elastic braids are these threads covered with silk and other material. In woven fabrics, caoutchouc thread makes the warp, alternately with threads of stuff to receive the extreme strain that would destroy the rubber, and the other materials form the weft, or cross-threads. When woven, a hot iron is passed over the stuff, and this causes the rubber to regain its elasticity. Another mode of forming the threads perfectly round and smooth, is to convert the caoutchouc into a soft paste. This is done by macerating it for some hours with about twice its weight of sulphuret of carbon, adding 5 per cent. of alcohol. The paste is well kneaded by compressing it through diaphragms of wire gauze, placed in cylinders, and is then forced through a line of small holes at the bottom of another cylinder. The threads, as they issue, are taken on a web of velvet, from which they pass to another of common cloth, and are carried slowly along for 600 to 700 feet, when becoming dry and hard by the evaporation of the solvent, they are received in a little cup. The threads produced of vulcanized rubber retain their elasticity, and are, when woven, kept stretched by weights. On releasing them, the material woven with them is drawn back, producing shirred or corrugated fabrics.

Caoutchouc supplanted the metal elastics for many purposes, since it would not corrode in moisture. It was at once in demand for suspenders, garters, corsets, and numberless appurtenances of apparel.

It came to be used for water-proofing cloths, surgical instruments of all kinds, elastic bands, in the arts and trades. Bookbinders have used it for securing the leaves in books, imparting flexibility and freedom to the opening volumes. In thin sheets, it has been used for taking impressions of engravings. In this form, also, it is an excellent material for covering the mouths of bottles, and similar applications requiring the exclusion of air and moisture. Prepared with other ingredients, it forms a marine glue unsurpassed in adhesiveness when applied to wood. A pound of fine rubber is dissolved in four gallons of rectified coal-tar naphtha and well mixed. In ten or twelve days this will attain the consistency of cream, when an equal weight of shellac is added. It is then heated in an iron vessel having a discharge pipe at the bottom. As it melts, it is kept well stirred, and the liquid flowing out is obtained in the form of thin sheets. When it is applied, it is heated to 248° and applied with a brush, and retained soft until the jointing is made, by passing heated rollers over the surface. This has been, it is said, applied to masts of vessels, which have been so firmly spliced that fractures take place in the new wood sooner than to separate the glued portion; and it has been held that parts of vessels may be, by these means, so firmly put together that iron bolts would be unnecessary.

Rubber has been made use of for paving stables, lobbies, and halls, here, as well as in England, where Windsor Castle carriage-way is so paved. There are a multitude of uses for the material, such as baths, dishes for photograph and chemical purposes, telegraph wire covers, boots, shoes, toys, life-preservers, clothing, furniture covers, travelling bags, tents, beds, water pails. It is being constantly applied to new uses, as the chemical modes of treating the article develop new properties.

The uses of the article were, however, still comparatively limited. The water-proof qualities were, to some extent, availed of, and its elasticity was ingeniously applied in many minor directions. The native article itself was still an impracticable object in the manufacture. It had baffled the philosopher, the chemist, and the artisan in investigating its nature and in controlling its properties. Repeated attempts were made to transport the pure juice or gum to Europe, there to be operated upon, but without success, since it was found that it rapidly degenerated. A method of doing this was finally devised by Mr. Lee Norris, of New York. The liquor is first filtered and mixed with ⅕ its own weight of ammonia. On being poured out on any smooth surface, and exposed to a temperature of 70° or 100° of heat, the ammonia, which had preserved it from the action of the atmosphere, is evaporated, and leaves the gum in the form of the object which holds it. Its intractable nature was finally, however, conquered by Charles Goodyear, who controlled it, apparently, as Rarey does horses, viz., by producing the result without any one being able to explain the phenomenon. Mr. Goodyear spent 20 years of the most unremitting toil in experimenting upon India-rubber, and finally discovered that a mixture of sulphur, white lead, and caoutchouc, exposed to regulated temperature from 8 to 12 hours, becomes "vulcanized," or an entire new substance unlike any other. The native rubber, being exposed to the extremes of heat and cold, is destroyed; but those agencies have no effect on the same article vulcanized. The liquids which dissolve the pure rubber do not influence the new article, which, however, acquires a far higher degree of elasticity — becomes, in fact, an "elastic metal." The article, when put into the heaters, is a tough, sticky, unelastic dough. It comes out endowed with a high degree of elasticity, insensible to heat, or cold, or solvents, and applicable to almost every want of life. It has been since discovered that the white lead contributes but little to the change undergone in the heaters, the cause or manner of which has baffled the skill of the most scientific chemists in this country or Europe. In mixing the proportions of the compounds, reference has always been made to the nature of the objects to be manufactured. The form and adaptation of the articles are perfected before the "vulcanizing." The general mode of preparing the rubber is the same. The rubber imported from the East Indies is said to be of a stronger fibre than that of South America, and the gum is selected in accordance with the manufacture proposed. It is imported in rude masses, in which sticks, leaves, and dirt are thickly mingled. These are about 2 feet long and 1 foot thick. The first process that the gum undergoes is the expensive and laborious one of cleaning, by which the mass loses about $\frac{1}{5}$ of its weight. A large vat is filled with hot water, and in this the rubber remains until the exterior is sufficiently softened to allow of the removal of the coarse basket-work that covers and adheres closely to it. When this is done, the lumps are, by means of a circular knife of a diameter of 4 feet, revolving with great speed under the influence of powerful machinery, cut into slabs about 1 inch thick. The engraving will give a good idea of the operation. These slabs are then carried to the "cracker," of which an illustration will be found on another page. This is formed of two large cylinders grooved longitudinally, and revolving slowly but irresistibly. Between these the slabs, as they are passed, are elongated and twisted, by which operation much of the dirt and bark works out. The stretched slabs are then taken to the washing machine, where numerous sharp knives, revolving under the water, cut it into small pieces, as seen in the baskets on the right of the illustration, which, at the same time, are kneaded and washed until they are thoroughly cleansed. They are then ready for the grinding machine. This consists of large hollow cylinders, made of cast iron, and revolving in opposite directions. The small pieces that come from the washing machine, being fed in, are kneaded by the cylinders again into thick sheets or mats. With this process the preparation is suspended for several months in order to allow the mats to be thoroughly dried and cured by the action of the air. This involves the necessity of keeping on hand a large stock of rubber.

When the rubber is quite cured, it is taken to the mixing machines, where it is to be combined with the various metals and substances to which the metallic rubber owes its peculiar properties. The mixing machines, like most of those used in the manufacture, are hollow revolving cylinders. The mixing cylinders are of great size and strength, and acquire the necessary heat to work the rubber from the steam let in at the ends. These, revolving toward each other, knead the rubber like dough. In the process, a constant series of explosions, like pistol-shots, is caused by the air confined in the folds of the substance being forced out by the action of the cylinders. This, on a grand scale, repeats the boy's amusement of chewing rubber soft in order to explode on his fist the air-bubbles created in it. As the rubber softens under this action, the workman slowly mixes in the various substances required. These consist mostly of sulphur, to which are added the oxides of various metals, zinc, lead, iron, etc. Here the greatest skill of the manufacturer is brought into requisition. Every quality of rubber requires a different compound, and every difference in the compound requires a different treatment in the subsequent stages of the manufacture. Thus prepared, the substance is ready to be moulded and shaped into the various forms in which it is to be finally perfected and used. The modes of preparation are various, according to the ultimate object—whether that may be for it to assume the form of the hard, unelastic comb, a door spring, a steam valve, a carpet, or any of the thousand shapes it is made to take.

It may be here remarked that the discovery, great as it was, was but the first step in the great series of improvements that has resulted from it. After 18 years of incessant labor, Mr. Goodyear had perfected a raw material—but a raw material for what? It was necessary to know to what articles it could be applied before there could be any demand for it; until then it was of no marketable value. It was necessary to invent or discover all the uses to which it might be applied. The shoe business was the first to make it available; but since then, vast as has been the number of manufactures based on it, discoveries are being daily made to extend it.

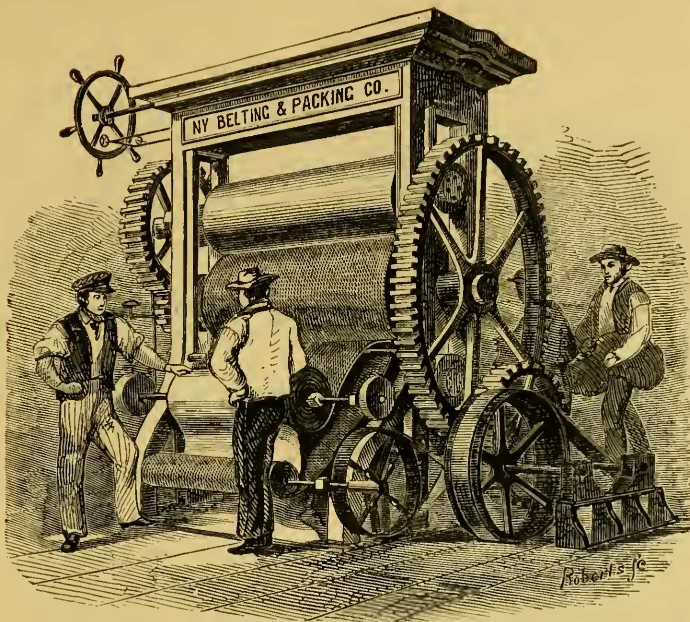
The manufacture of "belting" and "hose" is a very large business. The belts are used for driving machinery, and are superior to every other means. They are stronger than the best sole leather, and adhere to the drum or pulley with a tenacity that prevents slipping. This manufacture is a peculiar process. Cotton duck, similar to that of which sails are made, is woven in a mode to give double the usual strength longitudinally. This duck is impregnated with the rubber, under the influence of powerful machinery, which drives the substance through and through its meshes. It is then taken to the calender machine, seen in the engraving. The large cylinders of which it is composed have a perfectly polished surface. The rubber having gone through the mixing process, is in the shape of sticky, slate-colored dough, and passing through the calenders, is rolled out into a perfectly even sheet, upon the prepared duck. When this is completed, the "bolts" are taken to the belt-room, spread out upon tables 100 feet long, and cut into the strips desired for the various kinds of belting. For one of great strength, several of the strips are placed one upon the other, and then pressed together with immense power, by rolling-machines; thus giving them the strength of metal, with the peculiar friction surface found only in rubber. The belts are now ready for the heaters. These are long steam boilers, the door of which being opened, there is drawn out a long railway carriage. On this are placed the goods, which are then rolled in, the boiler closed, and steam admitted. In from 8 to 12 hours, the singular transformation known as vulcanizing, takes place.

The manufacture of "Croton hose" is similar. A long iron tube, of the proper diameter (and hose is made from $\frac{1}{4}$ inch to 12 inches) is covered with a sheet of carefully-prepared rubber. This, however, intended to be pliable, would not of itself be of sufficient strength to sustain a strong head of water, hence it is covered with webs of cloth prepared in the manner of the belting duck. When a sufficient number of folds have been applied to give the required strength, an outside covering of pure rubber is applied. A heater of immense length then receives the pipes, with the hose on them, to be cured by the same process as the belts. The hose is then drawn off the pipe to be subjected to proof. This hose will withstand a pressure that will burst the most powerful leather hose.

One of the most useful applications of vulcanized India-rubber, is steam packing. The vulcanized rubber is the only material that will preserve its elasticity and counteract the expansion and contraction of metals exposed to the heat of steam, thus making a joint perfectly steam-tight. It is used to pack round piston rods in steam machines; to place between the iron plates of steam pipes, wherever a joint is required; for gaskets, valves, and rings. Some ocean steamers have huge rubber valves, five feet in diameter, which play up and down in the vast cylinder, opening and shutting like the valves of a colossal artery. The use of rubber is now so great a necessity, wherever steam is used, that the mind wonders how it could ever have been dispensed with. It is not only steam, however, but every branch of mechanics that demands its presence, in the shape of sheets, plates, rings, hollow ellipses, of all imaginable forms and sizes, of which none but a mechanic can conceive the number applicable to his own art.

The use of rubber for car-springs has become almost universal. The high degree of elasticity which the sulphur imparts, makes that application an admirable one, and the more so that it does not lose the elasticity by prolonged use.

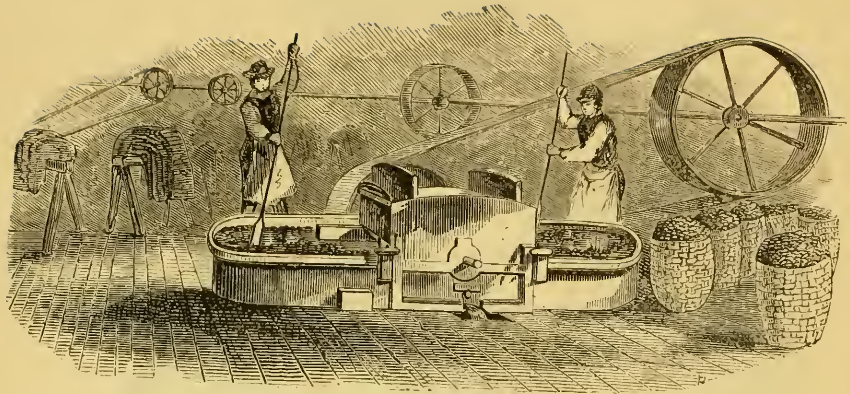
The "elastic metal" supplants the rigid one in numberless uses. House-sinks, in-



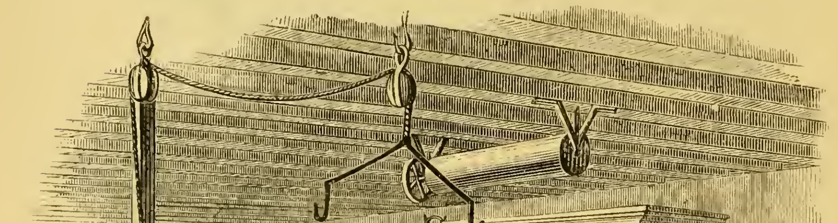

THE GREAT CALENDER MACHINE.

FICUS ELASTICA, FROM THE EAST INDIES.

CUTTING RUBBER INTO SLABS FOR THE WASHING MACHINES.



MACHINE FOR WASHING INDIA-RUBBER.



INDIA-RUBBER GRINDING MILL.

stead of cast-iron, are now formed of rubber, without joint or seam; and these are far less fatal to the china washed in them than were the metal ones. Springs for doors, from this material, supplant all others. These, for churches, are so arranged that the door may be closed, or held open to a desired distance. For bed-springs, it has become the most desirable, durable, and luxurious material. Carpets and mats for halls, stairways, and public rooms are formed of it, of infinite variety and usefulness. One of the manufactures of rubber goods which has taken the greatest extension in the decade 1870 to 1880 is that of water-proof cloaks for ladies' wear. A light but firm cambric is coated with a very thin but complete coating of rubber, and is then made up into a cloak enveloping the whole person. These gossamer cloaks weigh but from eight to ten ounces, some of them even less than this, and they can be folded and carried in a small satchel or case about eight inches in length and five in circumference, but they are perfectly water-proof. The mixture of lead in the compound was found to make it more compact and heavy, but the peculiar properties are apparently attained as well without the use of the lead. The combination with sulphur has been effected by exposing the material to the action of sulphurous fluids, as the sulphuret of carbon and the chloride of sulphur. An immersion of one or two minutes in a mixture composed of forty parts of sulphuret of carbon to one of chloride of sulphur, kept at the usual high heat, will produce the vulcanization. For the purpose of imparting that hardness which is manifest in combs, fancy boxes, canes, buttons, knife-handles, and all those forms in which it has supplanted bone, shell, and ivory, magnesia is introduced, and gives a lighter color to the articles in which it is compounded. In the manufacture, articles are buried in pulverized soapstone, to be vulcanized by the introduction of highly-heated steam. The effect upon the commerce of the country is seen in the following table. The largest proportion of caoutchouc used in the world comes from South America.

| Years. | Rubber imported. | Shoes exported. Pairs. | Value. | Other rubber goods. | Total Value. |
|---|---|---|---|---|---|
| 1856,.... | $1,143,372 | 625,220 | $427,936 | $665,602 | $1,093,538 |
| 1858,.... | 755,828 | 247,380 | 115,931 | 197,448 | 313,379 |
| 1861,.... | 1,287,069 | 33,603 | 160,088 | 193,691 | 353,779 |
| 1880,.... | 9,606,239 | 13,980 | 28,072 | 278,608 | 306,680 |

There have been great vicissitudes in the manufacture of goods under Goodyear's patents. Numbers of companies have been formed in Connecticut, New York, Newark, New Brunswick, Millstone, N. J., and elsewhere. The progress of the manufacture has been very rapid. In 1850, the value of the rubber goods made in the United States was $3,024,335. In 1860, it amounted to $5,642,700, an increase of 86.6 per cent. In 1870, the number of establishments was 56; capital, $7,486,600; hands employed, 6,025; value of the products, $14,566,374. The statistics of the manufacture in 1880 are not yet reported, but the advance has been enormous all along the line, and the annual product of the hard and soft vulcanite must exceed $30,000,000. The hard rubber, or vulcanite, is used for jewelry, buttons, dress ornaments, pencils, canes, etc.

Gutta percha is used extensively for similar purposes as the caoutchouc, and is prepared in the same manner by Goodyear's process. It is a gum found in the trees of the Malay peninsula, and procured in the same manner as caoutchouc. European attention was first called to it in 1842, and it began to be imported in 1844. Its chemical composition is identical with that of India-rubber, except that it contains oxygen, which rubber does not. It has a number of qualities that make it preferable for certain uses. It is a bad conductor, and is therefore very applicable as a covering for telegraph wires, and its peculiar acoustic properties make it valuable for speaking-tubes in public houses and large establishments. The application of gutta percha to the coating of telegraph wires is claimed by Mr. Samuel J. Armstrong, of New York, who for that purpose modified the machinery for gutta-percha tubing. The first machinery built for that purpose was in 1848, and the first wire so coated was laid across the Hudson river, at Fort Lee, in August, 1849, for the Morse Telegraph Company. This machinery was furtively carried to England, and there used for the Atlantic Telegraph. The articles made of gutta percha alone, or mixed with other substances, are of very great variety—ornaments, vessels, articles of clothing, fancy articles, surgical articles, dentists' and numerous other articles. Vessels have also been made of it, and its uses are being daily multiplied.

PAST.

PRESENT.

# SEWING MACHINES.

The decade 1840–1850 was the most fruitful in useful and practical inventions for the benefit of humanity, of any ten years of the present century. To it belong those inventions which made the telegraph a reality; the daguerreotype and photograph; the vulcanization of Indian rubber and gutta percha; and though last, perhaps most valuable of all, the Sewing Machine. Unlike most labor-saving machines, this, though it has undoubtedly lightened to some extent the labors of the individual woman, has vastly increased the amount of labor, and the number of laborers in the aggregate. Through the multiplication of sewing machines, an amount of sewing is now accomplished every year which would have been impossible thirty-five years ago, if every daughter of Eve, of adult age, had worked with the needle from early morn to the evening twilight. And the demand for needle-work, since it can be done by machines, keeps steadily ahead of the supply.

We propose then, at the close of the first generation since the sewing machine became a practical addition to human labor, to review its history, without injustice to any of the inventors who have immortalized their names in connection with it, and to classify, as far as possible, the different machines which have been and are candidates for popular favor.

The idea of sewing by machinery is more than a hundred years old, but the earliest efforts to give practical expression to this idea were unsuccessful. The first on record was a machine patented in England July 24, 1755, by Charles F. Weisenthal; this had a needle with two points and an eye at mid-length. Its purpose was rather to make the tambour-stitch of the embroiderer, than to perform any ordinary sewing.

The next sewing machine was that of Thomas Saint, of England, who obtained a patent July 19, 1790. This man seems to have understood, with remarkable clearness, the main essential features of the invention, for his machine had a horizontal cloth-plate, an over-hanging arm, at the end of which was a needle working vertically, and a "feed" working automatically between the stitches. These features have been preserved in every successful machine ever made. The needle was notched at the lower end, to push the thread through the goods, which had been previously punctured by an awl. As the needle passed upwards, leaving a loop in the thread, a loop-check caught the loop and held it until the needle descended again, enchaining the thread of the new loop in the former one.

In 1804, an Englishman, named Duncan, made a chain-stitch machine, having a number of hooked needles, which passed through the cloth and were supplied with thread beneath the goods by a feeding needle, whereupon the needles receded, each drawing a loop through the loop previously drawn by itself through the cloth.

In 1818, Rev. John A. Dodge, of Monkton, Vt., invented, and, with the assistance of John Knowles, an ingenious mechanic, constructed a machine having the double-pointed needle and eye at mid-length. It made a stitch identical with the ordinary "back-stitch," and was furnished with an automatic device for "feeding" the work. Mr. Dodge never applied for a patent, nor attempted to manufacture any more machines, because of the great pressure upon his time as a pastor, and further on account of the bitter opposition of journeymen tailors, who denounced the machine as an invasion of their rights.

The first patent issued in America for a sewing machine was that of a man named Lye, in the year 1826. Lye's device could hardly have contained any useful or striking features; for when the fire of 1836 destroyed all the Patent Office Records, it consumed all that remained of this machine.

In the year 1830 Barthelemy Thimonnier, a Parisian, invented a machine which operated much as Saint's did, except that the needle was crochetted, and, descending through the goods, pulled up a lower thread and formed a series of loops upon the upper side of the goods. Eighty of these machines, made of wood, are said to have been used in 1830 in Paris, for making army clothing; but were destroyed by a mob on the plea that they were depriving journeyman tailors of their daily bread. Thimonnier escaped and made other machines, of metal; but these, though patented in France in August, 1848, and in the United States September 3, 1850, had too many defects to become anything more than an important step in the onward march of this great invention. The inventor died in great poverty in 1857.

The next approach to success prior to 1846 was made by Walter Hunt, of New York City, in the years 1832–3–4. His machine had a curved needle, with an eye near the needle-point, which was operated on the end of a vibrating arm. A loop was formed beneath the cloth by the needle-thread, through which a shuttle, reeling off another thread, was forced back and forth with each stitch, making an interlocked stitch like that now made by the best machines. George A. Arrowsmith, a blacksmith, of Woodbridge, N. J., being of a speculative turn, bought one-half of Walter Hunt's invention in 1834, and afterwards acquired the remainder. Soon afterwards, Adoniram F. Hunt, a brother of Walter, was employed by Arrowsmith to construct some sewing machines upon the same principle, but differing somewhat in arrangement of details from the original. These machines were made and operated at a machine shop in Amos street, New York City. Arrowsmith neglected to obtain a patent upon the machine for reasons which, in the light of events now past, make singularly interesting reading. He assigned three reasons for not procuring a patent: (1) He had other business; (2) the expense of patenting; (3) the supposed difficulty of introducing them into use, saying, it "would have cost two or three thousand dollars to start the business." There appeared also a prejudice against any machine which had a tendency to dispense with female labor. A proposition made by Walter Hunt to his daughter to engage in the corset-making business with a sewing machine was declined, after consultation with her female friends, principally, if not altogether, as she afterwards testified, "on the ground that the introduction of such a machine into use would be injurious to the interests of hand-sewers. I found that the machine would at that time be very unpopular, and, therefore, refused to use it."

About 1852 Walter Hunt bought back Arrowsmith's interest in his machine, and applied for a patent, but was refused on the ground that, although unquestionably the inventor, he had forfeited his rights, by his neglect and the sale of his invention. In 1841 Newton and Archbold patented the eye-pointed needle in England, although it had been used certainly for eight and possibly for twenty years in this country.

The next patent issued in this country

for a sewing machine was granted February 21, 1842, to J. J. Greenough, of Washington City. This machine used a needle having two points and one eye, and made the "through-and-through," or shoemaker's stitch. Whatever may have been its merits, it proved of no value to the public, as very few machines were ever built. A machine for making the "running" or "basting" stitch was patented March 4, 1843, by B. W. Bean, of New York City; but we believe that no machines were ever built for sale. A patent was granted, December 27, 1843, to Geo. R. Corlies, of Greenwich, N. Y., for a machine similar to Greenough's; but like his, there were few if any machines ever put upon the market.

Except possibly one or two other machines like Bean's, making the running stitch, the next sewing machine patent of any importance was that granted to Elias Howe, Jr., of Cambridge, Mass., in 1846. Howe was but an indifferent mechanic; his inventive genius was far inferior to that of Thimonnier or Walter Hunt, or to any of the hundreds of skilled workmen who have since done so much to make the sewing machine perfect, but he possessed indomitable will, patience, and perseverance; and though at first the outlook was gloomy enough, yet in the end fortune favored him far beyond his deserts. His own story was that he first grappled with the idea of constructing a practical sewing machine in 1843, but for a year approached no nearer to his ideal, than at first; in 1844, he claimed to have invented the eye-pointed needle, and the interlocking shuttle, both of which had not only been invented but used in sewing machines by Walter Hunt twelve years before, and, as he afterwards admitted, he knew that they had been invented; the eye-pointed needle had, moreover, been patented in England three years before. In 1845 he had a machine which worked fitfully and intermittently, and for this in Sept., 1846, he obtained a patent. Dr. E. H. Knight, in the American Mechanical Dictionary, thus describes the machine: "It had a curved eye-pointed needle attached to the end of a vibrating lever and carrying the upper thread. The shuttle carrying the lower thread between the needle and the upper thread, was driven in its race by means of two strikes, carried on the ends of vibrating arms, worked by two cams. The cloth was suspended by pins from the edge of a thin steel rib called a baster-plate, which had holes engaged by the teeth of a small intermittingly moving pinion. This was the feed." His claim, granted in his patent, covered, broadly, the formation of a seam for uniting two pieces of cloth, by the combined action of an eye-pointed needle and shuttle, or their equivalent, interlocking two threads. The whole machine was crude and imperfect, and until materially modified by able and more skillful mechanics it was never able to do good or continuous work. Among other difficulties, two seemed insuperable: the baster-plate did not answer any good purpose as a *feed*, and the vertical suspension of the material was both awkward and objectionable; the tension was not regulated, so that the machine would skip stitches, make large loops at some places, and draw the thread too tightly at others.

Machinists who attempted to sell and introduce the machine found themselves unable to do so; the tailors and seamstresses all opposed it, and the few who were willing to try it, were unable to make it work satisfactorily. They could only sell territorial rights for its manufacture, and this was really a fraud, as nobody could make the machines work. Indeed, looking at the matter with the experience of thirty-six years, it seems wonderful that this worthless machine did not absolutely kill the production of anything like a sewing machine for the next fifty years. The good points about it, the eye-pointed needle, the shuttle and the interlocking of the two threads in what is known as the "lock-stitch,"—were not of his invention but had been known and used previously, while everything he did invent failed to work, and has long since been abandoned. Among these things were the curved needle, the needle-arm, swinging like a pendulum in an arc of a circle, the clamp or baster-plate, and its vertical position, the feed motion, the two shuttle-drivers entirely distinct from each other, and the single acting treadle. It is a sufficient commentary on his own subsequent opinion of these inventions that when, ten or twelve years later, Mr. Howe entered upon the field with a machine of his own, not one of these peculiar inventions found a place in it. The broad claims of his patent to the eye-pointed-needle and the shuttle and lock-stitch, saved him from financial ruin, and inflicted upon the public a very heavy contribution for his support.

For five years after receiving his patent, Mr. Howe's invention lay substantially dormant. It is doubtful whether a single machine constructed by him, or by machinists who strictly followed his specifications in this patent, ever could be made to do any continuous, or satisfactory work. His brother, A. B. Howe, who built most of his machines, and who made some improvements which enabled them to be used with moderate success, was in the habit of saying, years after, that Elias Howe never made a machine that would work. The two brothers went to Europe in 1847 or 1848, and secured a patent in England in the name of another party; but after repeated trials they were unable to make a satisfactory machine, and returned so poor, that Elias Howe was obliged to pawn his effects for his wife's homeward passage, and to work as an ordinary deck hand for his own.

Meantime other and more skillful mechanics were busy inventing sewing-machines which might prove of more practical value. The first patent for an improvement upon Howe's machine was issued to John Bradshaw, of Lowell, Mass., for a device to regulate the *tension* of the thread, and was dated Nov. 23, 1848. On the 6th of February, 1849, J. B. Johnson and Charles Morey, of Boston, Mass., obtained a patent for a machine, having a *circular* or *continuous* baster-plate, which was an improvement upon the *straight* baster plate of Howe; but other and more valuable improvements, for the same purpose, soon superceded this. May 8, 1849, John Batchelder, of Boston, Mass., obtained a patent for an improvement to regulate the feeding of the cloth, automatically, by the machine. And about the same time a patent was also granted to J. S. Conant, of Dracut, Mass., for an improvement designed to accomplish the same purpose, by a different arrangement. Both Morey and Johnson's and Batchelder's machines, and, we believe, Conant's also, were single-thread machines, making the *loop* or *chain-stitch*, and having new devices, both for feed and tension. Batchelder's feed had a rotating-pin surface, moving about a horizontal axis, and carrying the material over a horizontal cloth-supporting surface. Johnson invented the needle-feed, which possessed considerable merit, and which was, with some modifications, revived fifteen or eighteen years later. On the 2d of October, 1849, Blodgett and Lerow, of Boston, obtained a patent for a machine to make the shuttle-stitch by a method different from that of Howe, the shuttle describing a *circle* instead of moving *back and forth.* The introduction of this machine, though it was clearly an infringement of Howe's patent, proved a decided advantage to him, as a considerable number of the machines were made and sold, and their operation, though far from perfect, did much toward convincing the public that sewing *could* be done by machinery. Blodgett was a tailor, and had attempted to sell Howe's machines, and his knowledge of their defects led him to invent an improvement. On the 12th of Nov., 1850, Mr. Allen B. Wilson, since and now of the Wheeler & Wilson Manufacturing Company, patented a machine with two improvements; one a new device for feeding the cloth, termed the "two-motioned feed," (afterwards improved and patented again as "the four-motioned feed,") the other a shuttle, pointed at each end, which made a stitch *at each movement*, while in Howe's machine the shuttle had to go and return at every stitch. This greatly expedited the sewing, and was a decided advance on Howe's machine, but it did not satisfy the inventor, and was eventually abandoned.

Pursuing the strict chronological order of the issue of the patents, we come next to that of Mr. William O. Grover, and his subsequent partner, Mr. Baker. These gentlemen patented Feb. 11, 1851, a sewing machine having two distinguishing features, viz., the *double loop*, or Grover & Baker stitch, and the method of producing it, which was by a circular under needle, as a substitute for the shuttle, which reciprocated with a curved eye-pointed needle above. In the summer of 1851, Mr. Grover, without any knowledge of Mr. Wilson's invention of the "four-motioned feed," invented a feed device substantially similar to it, for which a patent was issued to Grover & Baker June 22, 1852. There was at first some difficulty between Mr. Wilson and Messrs Grover & Baker in regard to this feed, but it was compromised, and both companies, as well as many others, have since used this arrangement.

In September, 1850, Mr. Isaac M. Singer, an ingenious mechanic, then living in Boston, but subsequently of New York, who was familiar with Blodgett & Lerow's machine, made an agreement to invent an improved sewing machine, and to have it built for forty dollars, two of his friends, Messrs. Phelps and Zieber, who had assisted him, being equally interested with him in it. He built it in eleven days, using the eye-pointed needle and shuttle, but making his needle straight instead of curved, having a needle bar moving vertically, turning Howe's baster-plate over upon its side so as to make it horizontal instead of vertical; inventing a roughened feed-wheel extending through a slot in the top of the table, attaching his two shuttle carriers to the same bar, and causing the shuttle to move steadily and regularly in a horizontal groove, contriving a spring presser-foot, by the side of the needle, to hold the work down; an adjustable arm for holding the bobbin containing the needle thread (this was subsequently abandoned), and a double-acting treadle. Though the machine resembled Howe's in many respects, it contained many new features, and when its tension was regulated, worked well. It is somewhat remarkable that all these inventions of Mr. Singer, with one exception, are retained to this day in some of the Singer machines. Those machines are much better finished now, and work with but little noise or clatter; they have changed somewhat the modes of distributing their motive force, but in all essential particulars the principles are substantially the same, as when Isaac M. Singer completed his first machine in Boston. This machine was not patented till Aug. 12, 1851

On the same day, Aug. 12, 1851, Mr. Allen B. Wilson, who had abandoned his shuttle machine, and had been busily engaged for several months in perfecting a new idea, patented a new machine, having associated Mr. Nathaniel Wheeler with himself in the patent. This machine had no shuttle, but a rotating or revolving hook, which carried within its concavity a double convex circular bobbin, and a concave ring which held it in place. This hook caught the loop from the descending eye-pointed needle, which was slightly curved, and passed it around the bobbin, which thus performed the function of the shuttle.

These three companies—the Grover & Baker, the Singer, and the Wheeler & Wilson Sewing Machine Companies—were for twenty years and more known as the "three great companies," or after their arrangement with Mr. Howe, the "Great Sewing Machine Combination," which for more than twenty years exacted tolls from every manufacturer of sewing machines in the country.

As we have already said, Howe's patent, like his machines, lay dormant for five or six years, and these three companies had gained a footing which, though it was the result of hard labor, and in defiance of opposition from tailors and seamstresses, and indeed from every class who used the needle in their work, and of scoffing unbelief from the hundreds and thousands, who were convinced beforehand that the whole thing would prove a failure, seemed likely eventually to give them ample reward for their toil.

They were destined to be awakened, rather roughly, from this sweet dream of peace. Mr. Elias Howe, who had never made a machine which would work satisfactorily, notified them that he held patents which they had infringed, and that they must immediately cease manufacturing, until licensed by him, must pay $25,000 each for their past violations of his patent, and agree to pay him a heavy royalty for every machine they should make in the future. At first all resisted this preposterous demand; but the patents had been well and carefully drawn, and though they claimed for Howe points to which he was not entitled, yet there was great difficulty at that time in proving their invalidity in a court of law, and meantime their business would be ruined. The next two or three years were prolific in law suits, but Grover & Baker, and Wheeler & Wilson, having compromised, Singer & Co., who had stood out longest, and were regarded as the chief offenders, came into the combination, which, from 1854 to 1877, largely controlled the entire sewing machine production in the United States. Howe had exacted from 1851 to 1853 the sum of $25 for every sewing machine made by any manufacturer. In May, 1854, Singer & Co. paid him $15,000 royalty on the machines they had already manufactured, and by the "Albany Agreement" the three companies agreed, until the expiration of his patent in 1860, to pay him $5 each for every machine they should make, except those which they exported, and to exact from all other manufacturers outside of the combination $15 royalty for each machine manufactured, this royalty including, however, the patents held by the three companies, on the four-motioned feed, form of the needle, form of the shuttle, etc., etc. Of this $15, five was paid to Mr. Howe, and the remainder divided between the companies according to their patents. In 1860 Howe's patent was renewed for seven years, but the royalty was reduced to $1 each for the three companies, and to $7 for the licensees. The combination was kept up, on the other patents and on some new patents which Howe had taken out, until 1877, when it expired, Howe and his heirs having received from it over two million dollars, and the three companies some five or six millions.

Until 1854 there were no new machine companies which possessed much vitality. In that year the Weed, which has been several times materially changed and remodelled, the Parham and the Finkle & Lyon, both now practically out of the market, were patented. In 1855 the Florence, once a very popular machine, but of late giving place to the "Crown," manufactured by the same company, was the most important of the new machines. These were all shuttle machines. From 1851 to 1860, Mr. Grover, Mr. Wilson, and Mr. Singer were very active in their efforts to perfect their machines, going over with great care the entire range of devices and principles which were supposed to be applicable to machine sewing, and canvassing with great zeal the comparative merits of shuttles of all forms, rotating and revolving hooks, every variety of feeds, tensions, take-ups, and all sorts of attachments. If they did not dis cover in those years every form or device which could be applied to sewing machines, it was not for want of diligence, research, or mechanical skill. Doubtless they did overlook some points which have been since discovered; but of the numberless sewing machine improvements and attachments which have been offered for patents in the Patent Office within the past five years, it will be found that very many (and some of them patented) are the ideas of these skillful inventors presented under a new form.

In 1867, a sewing machine involving a new principle, or at least a new application of it, was patented. The patent was granted to Mr. James E. A. Gibbs, of Millpoint, Va., for a machine with a rotating hook, using a single thread, and making the *twisted-loop stitch*, a variety of the chain-stitch, not liable to the objections made to that stitch. This machine was subsequently much improved by the addition of other devices, and particularly of the tension, and form of the hook, by Mr. James Willcox, of Philadelphia, and his son, Mr. Charles H. Willcox, both skillful mechanicians. It has become widely known as the Willcox & Gibbs Automatic Sewing Machine.

The Empire (since consolidated with the Remington) a shuttle machine, the Slote or Elliptic, having a hook with elliptic motion, which came under the Wheeler & Wilson patents, and was subsequently owned by them, but is now out of the market, and the two Howe Machines, (the Elias Howe and Amasa B. Howe) both shuttle machines, were all patented in or about 1858. We think neither of these are now manufactured to any considerable extent, though the "Elias Howe" at one time had a very large sale, especially for leather work. The American Button Hole and Sewing Machine Co., the Aetna (now we believe defunct), and the original Domestic, under Mack's patents, were all put upon the market between 1860 and 1864. These were shuttle machines. The Beckwith machines, now out of the market, one making the loop stitch, the other the double-loop, or Grover & Baker stitch, and both having a modification of the needle-feed, with a smooth plate and a vibrating needle-bar, were first patented in 1865. They were hand machines, and had a considerable sale. When Howe's original patents,as extended,expired in 1867, a large number of new machines were put upon the market. Among these were the Victor, a successor, with considerable improvements, of the Finkle & Lyon, the Remington, which soon absorbed the Empire, the Aetna, the Bartram & Fanton, the Bartlett Reversible (all we believe now extinct), and the Domestic, which, under its new owners, with important improvements, presently stepped into the front rank of new machines, as involving a combination of principles which, though not new, had not previously been brought together in one machine. About the same time, too, appeared the "Davis" machine, which, with some improvements, became somewhat later a leading machine and the type of an important class—the Secor, Blees, Whitney, and Braunsdorff's new Aetna—all now out of the market, were among the other machines of this period. This brings us to the Centennial year, and indeed to 1877, when the last patents of the great combination expired. Although it seemed at the Centennial Exposition as if the world was full of sewing machines, and the great companies were so strong that all further competition was useless, unless backed by a capital of at least a million dollars, yet from 1877 to the present time (1882) more than fifty sewing machines have been patented, and of these at least forty are now actively engaged in manufacturing, and the sales of the new companies in 1880 were nearly 350,000 machines.

The greater part of these were shuttle machines, though two or three had some contrivance for producing a chain or double-loop stitch, and it was remarkable in how many cases old, forgotten, or rejected devices, were invented anew. The greater part, however, had some new device for producing, changing, or modifying the running gear, some using cams and rocking shafts, some eccentric levers, some the bevel gearing, some applying the force from above, and controlling the under action by force transmitted from the arm, while others controlled the action of the needle-bar, presser-foot, and feed from a shaft or eccentric under the plate. The form and action of the shuttle and shuttle-carrier was the subject of many patents; the shuttle race was straight, curved, or circular; the shuttle itself was round, flat, boat-shaped, or spherical; its action was straight-forward, curvilinear, oscillating, vibrating, or rotary; usually it went through the loop, but sometimes it furnished a loop, through which the needle passed. The feed was equally varied; the four-motioned feed rising from below and forcing forward the material, no longer reigned undisputed; there were needle-feeds, and feeds without needles; the four-motioned feed was transferred to the upper works of the machine, and descended upon a smooth or roughened plate, along with the needle-bar and presser-foot, stepping forward with each stitch; there were double feeds, one ascending from below as an auxiliary to the upper feed, already described, and acting uniformly with it to clamp the material that it might not slip, others acting independently; and if there is any other possible variety of feed, it has certainly been invented and adopted by some of these machines.

Another and very important feature claimed by these later machines, was their ability to manufacture larger articles of clothing or bedding, as manufacturing machines, from the greater height and length of the overhanging arm. The necessity of this has been, we think, overestimated. With machines making the lock stitch, there ought to be no difficulty in doing this work from the left side of the machine, as well as from the right, and thus avoiding the necessity of placing the work under the overhanging arm at all. Most machines have now extension-leaves to their tables, and there is certainly room enough, outside the machine, for the largest piece of work. Some of the new machines have recognized this fact; others would have saved money if they had done so. This enlargement of the overhanging arm necessitates the packing of all, or nearly all the running gear in that arm, and unless great caution is observed in making the parts for transmitting the force to the under side of the bed plate, strong and simple, there will be two results to follow, both of which will be objectionable; the racking of the top-heavy machine by the treadle motion will soon displace some of the smaller parts, and the machine will not work well—perhaps not at all; and the same racking motion will cause it to skip stitches, and to derange the tension to such a degree as to spoil the work.

Some of the new machines have made a specialty of the tension. We have automatic tensions, easily regulated and self-regulating tensions, besides some which are not so easily regulated. In every direction this preternatural activity is pushing its way, endeavoring to find or make some new combination, which will enable these eager inventors to produce a machine which shall be in some, perhaps in many respects, an advance upon all those that have gone before it. In many cases the result will be a complete failure, in some a moderate success, following in a path already indicated; in a very few there will be developed an originality, either in the application of mechanical principles, not new, but not hitherto applied successfully to sewing machines, in some way which will be a positive advance; or a new combination of principles heretofore applied, in such a way as to obtain better results with less labor. The sewing machine builder of the present day, may not hope to stumble, by any accident or ignorant blundering, upon any such good fortune as was possible, perhaps, thirty years ago; every step must be taken with a thorough mechanical knowledge of the result to which it leads, and there will be an absolute certainty, that oftentimes, when he supposes himself to be traversing fields hitherto untrodden, he will find the foot-prints of some previous inventor who has tested, and perhaps patented, the very invention on which his heart is set, only to find that it would not answer his expectation, and has consequently rejected or dropped it.

We have thus given a chronological history of the introduction of sewing machines upon the American market; let us turn now to a more interesting phase of the subject,—the gradual development of the sewing machine idea in the minds of inventors and the public, in these thirty-six years which have elapsed since Howe obtained his first patent.

The first idea which took possession of the minds of Saint, of Dodge, Thimonnier, Hunt, and Howe, and to some extent, also of Grover, Singer, and Wilson, was to produce a machine which would make stitches, and which when perfected, would enable the tailor or dressmaker to sew with somewhat greater rapidity than could be done by hand, the long straight seams. That it would do anything more than this, or that it would do even this, more than passably well, was an assumption, which had not at that time entered any of their minds.

Hunt and Howe were the first to make the lock-stitch, and to use the shuttle, and of the three eminent inventors who followed them—Grover, Singer, and Wilson; only Singer used the shuttle. There was a reason for this. In the first stage of the invention, there were three theories of machine-sewing which presented themselves to the minds of the inventors. Hunt, Howe, and Singer regarded sewing with two threads as a species of weaving, as it really is, and hence the shuttle naturally suggested itself to their minds as the thread-carrier. Saint, Thimonnier, and Wilson conceived the idea that machine-sewing was to be really a modification of the embroidery process, and the first two simply adapted their machine to the making of the tambour or single loop stitch, while Wilson, a more accomplished mechanic than the others, while employing the hook to pull up the loop of thread presented by the eye-pointed needle, deemed it necessary to pass it around his disk-like bobbin, and thus substantially introduced a shuttle of circular form. Grover, more strongly impressed than the others, with the idea that machine-sewing was only a species of embroidery, discarded all forms of shuttles, and formed his peculiar stitch, which was really an embroidery stitch, by means of a circular under-needle reciprocating with a curved eye-pointed needle above.

But, however different their theories of the stitch, they were substantially agreed in many other points. They all used eye-pointed needles, but neither they nor Howe had invented these; their running gear differed very little, and only in those points which their different action required; if one plan was preferable to another, Singer's ideas seemed to deserve the greatest credit, since his beveled gearing has remained substantially unchanged. In the matter of feeds, Wilson and Grover seem to have been more successful than Singer; the four-motioned feed, invented by them, having proved more satisfactory than Singer's wheel-feed. The tensions adopted by each differed very little, and all required frequent adjustment. Singer alone had at first a straight eye-pointed needle, all the others were curved.

At first it was very difficult to induce anybody to use a sewing machine. Its supposed sphere of action was limited; it could sew straight seams of considerable length; though, if the tension was not just right, and sometimes, if it was, from some other cause, no good work could be done on it. When after long and patient experiments and slight modifications, it began to come into use, it was still, for the most part, the manufacturers who wanted it: and new manufactures sprang up, which would not have had an existence, but for the sewing machine. The shirt manufactures took a new departure, and though nearly one-half the work had still to be done by hand, yet the price of shirts was greatly reduced. Ready-made clothing was also made more largely. As yet, everything had to be basted, and generally all corners turned by hand, and there was more than ever for the hand-workers to do. In leather goods not requiring a waxed thread, the machine was winning a reputation, and the heavy machines of Singer, and later of Howe, Weed, and Wheeler & Wilson, were in demand for their production.

About 1856 or 1857, the first considerable effort was made to introduce the sewing machine into families. Lighter and easier running machines were devised for this purpose, and soon several new machines were put upon the market. The Wheeler & Wilson Family machine, though not without some defects, proved for many years the most popular machine for family use, and by many of those who had become accustomed to its use, even their New No. 8, in many respects a much better machine, was received with many doubts of its superiority over the old favorite. These doubts were dispelled in time, and both new and old continue to be very popular. The Singer Company had also completed a family machine, which proved a great favorite. The Grover & Baker Company, then the leading company in the business, produced a shuttle machine for family use, while the Weed and Florence were claiming their share of the rapidly increasing business. Several other shuttle machines were also invented about this time, which subsequently attained reputation as manufacturing machines.

One new competitor for the family trade deserves special notice, not so much for the large amount of its sales, for others have greatly surpassed it in this respect, as for the new principles it involved. Receiving its first patent in 1857, and others for several of the following years, the Willcox & Gibbs sewing machine has been almost the sole representative of the single-thread twisted-loop stitch. It has fought its battles in behalf of this stitch, and the use of a single thread, with a gallantry and courage which has won the admiration even of its enemies; its addition of the automatic tension gave it a new prestige, and though it has never been exactly popular, in the sense of being the machine used by the poorer classes, it is well and favorably known and has many warm friends. For its light and noiseless running, its perfect tension, and its admirable finish, it has no equal among the numerous machines in the market.

The expiration of Howe's first patent in 1860, and the consequent reduction of the royalty under its extension to $7.00, was the signal for the introduction of several new shuttle machines upon the market, among them the two Howe machines, the Empire, American Button Hole, Ætna, etc. These were generally upon the Singer model, with some variations, though some of them had substituted cam movements for the bevel wheel gearing of the rotating horizontal and vertical shafts. At that time (1860) there had been a little more than 130,000 sewing machines sold under Howe's patent, of which about 55,000 were turned out by Wheeler & Wilson, 40,000 by Singer & Co., and 35,000 by Grover & Baker. Only 2000 Howe machines had been made up to 1860, and these with modifications, by A. B. Howe. Singer & Co., had led in the amount of sales from 1852 to 1854 ; Grover & Baker from 1854 to 1858; Wheeler & Wilson from 1858 to 1868, and Singer gained and has kept the leadership from 1868 to the present time.

The new sewing machines patented in 1860, had hardly begun to appear in the market, when the civil war commenced. The necessity for furnishing complete outfits, not only of uniforms, overcoats, caps, and shoes, but of underclothing, bedding, and hospital clothing, at once, for a half-million of men, soon to be increased to two millions, brought into immediate use every sewing machine which could be made to sew. In some of the eastern cities, where regiments were to be sent off in great haste, every lady who owned a sewing machine, sent it to a public hall, and following and using it herself, drove it night and day, Sundays and all, till the task was finished. Those were golden days for the sewing machines. They were manufactured in great numbers, set at work as soon as finished, and kept at work till the close of the war. It has been said, and we doubt not with truth, that the Union armies would have failed, if the agricultural machines, reapers, mowers, harvesters, horse-hoes, etc., had not been invented previously; that by the labors of the women and children with these machines, the great harvests were gathered, and the supplies for the armies and people kept up. With equal truth, we might say that but for the sewing machines it would have been impossible to clothe these vast armies, and to supply the hospitals with needed clothing and bedding; and at the same time to meet the home demand, reduced though it was, by anxiety that the soldiers should have the best. The Sanitary and Christian Commissions and their auxiliaries, disbursed during the war seventy millions of dollars in money and supplies, and fully one-third of this was for underclothing and bedding for the hospitals and camps.

The impulse thus given to the clothing, underclothing, cap, hat, and shoe trades, was not lost after the close of the war, but resulted in the manufacture on an immense scale of the underclothing for both sexes, of childrens' clothing, women's dresses and suits, even those of the cheapest material, and the better as well as the cheaper qualities of men's clothing; shoes and boots, caps and hats, the latter classes made on machines of peculiar construction, invented specially for their production.

There grew up also a great demand for the production of machines suited to the use of the milliner and dressmaker,—fine and delicate hemming, gathering, felling, tucking, binding, cording, plaiting, scolloping, braiding, ruffling, shirring, quilting, embroidering, making button holes, and trimming with the button-hole stitch. This was the era of *attachments*, not between the fair maids who operated the machines, and their male admirers, but attachments of quite another sort,—devices which, when attached to the machine, enabled the skillful operator to execute, with more or less perfection, all these kinds of work, which had previously been done only by hand. Here was another step forward; and the machine was so far perfected that it was able, when skillfully operated, to do almost everything which the most skillful needle-woman could do by hand. As yet, they had not attained to the art of sewing over and over, though even that is now probably accomplished, by an attachment recently patented. These attachments were adapted to the use of all the machines.

What remained to be invented? Not much, thought the great sewing machine companies in 1867, when the Howe patents expired, and the Victor, Remington, Domestic, Home, Davis, Secor, Blees, New Ætna, and Beckwith came forward as applicants for public patronage. All of these, except the last named, were shuttle machines, but some of them had developed new features of construction which made them formidable competitors for the honors which were waiting for the best machine. The Victor, Remington, Howe, Secor, Blees, and New Ætna were constructed much on the Singer model, an admirable one for many purposes, whose serviceable qualities have made it the leading machine in the country, in regard to the number sold; but, even with the slight changes made in the machines which were copied from it, it was asserted that it did not run so light, or with so little positive effort or noise, as some of the others. The Willcox & Gibbs machine had long reigned without a competitor in this particular, but now two or three of the new machines entered the lists with it. Foremost of these were the Home, Domestic, and Davis. The Home (not the "New Home") soon fell out of the race, but the Domestic and Davis have continued to this day. The Domestic combined in its construction three points not previously combined in one machine; the large and high arm, the rotary shaft in the arm, and the swinging shuttle below the bed plate. In all those machines which had adopted one or other of these devices, there had been a failure to secure the greatest advantages to be derived from them in consequence of the use of cams, bevel gearing, or other objectionable means of connecting them with the driving shaft and the other moving parts of the machine. The prime idea of Mr. Mack, the inventor of the "Domestic," was to secure all these advantages, with the minimum of disadvantage. He adopted the swinging shuttle-carrier and a rotary needle arm, thus giving the desired large space for work. He belted directly on to the needle arm, thus making it serve as a main or driving shaft for the combined systems. From eccentrics on this shaft, he gave motion to the shuttle and feed-moving devices by swing levers, thus operating the three systems of needle, feed, and shuttle movements without a cam, gear, or other objectionable device. His other improvements and inventions consisted of specific devices for carrying out the details of these and the other processes, such as tensions and take-ups, necessary for an efficient and popular machine. There is not so much originality of invention in this machine as in some of the earlier machines, but the admirable combination has resulted in producing a light-running, easily-driven machine, for either family or manufacturing purposes, so simple as not to be liable readily to get out of order, and capable of very rapid motion without much vibration. So marked are these advantages, that the Domestic has become not only the *pioneer* but the *type*, which has been followed, in its general features, by a considerable number of the new machines brought out since 1876 or 1877. Among these, the most prominent are the White, New Home, Dauntless, St. John, and Royal St. John, Eldredge, Crown, Fairbanks, Household, Springfield, New Stewart, Morrison, Hartford, and Boston.

The Davis sewing machine, originating in a town of moderate size, at a distance from the large cities, and not seeking the city trade at first, was longer in becoming generally known to the public than some of its competitors; but it possesses some new features which entitle it to special notice, and render it very popular.

In the Davis machine, the shaft, pulley, and fly-wheel occupy the same position, relatively, to the other parts, as in the Singer machine, and the vertical motion of the needle bar is produced by the usual crank-pin moving in a heart shaped cam; but there the similarity to the Singer ends. The arrangement for operating the shuttle, the motion of the shuttle (a swinging motion in a curved path), the shuttle-carrier, and the shuttle itself, are similar to those of the Domestic machine, as described above; but there is nothing under the bed-plate except the shuttle and the devices for operating it. The feed apparatus, which in principle resembles the four-motioned feed, is transferred from its usual position beneath the bed-plate to the head of the machine. It consists mainly of a vertical bar placed close to the presser-foot, which receives suitable vertical and horizontal motion from mechanism contained in the head of the machine.

The presser-foot, instead of being continuously urged downward upon the work, is lifted slightly at the instant that the forward motion takes place. The feeding is accomplished while the needle is in its lowest position, and the needle partakes of the forward motion of the feed-bar, pinning the two or more plies together, and causing both to advance equally. The goods rest upon a perfectly smooth surface, being held firmly by the presser-foot, until the feed has "stepped" forward. At this time the needle penetrates the fabric, the pressure is automatically transmitted to the feed (which comes down on the goods close behind the needle), and the *presser-foot is raised.* When the needle has reached its lowest point the full pressure has been transmitted to the feed, and it and the needle-bar are moved together the desired length of the stitch, both moving in unison at their highest and lowest points.

In practice, this vertical feed works admirably; the stitches are of uniform length, and there is no skipping; the two or more plies which are to be sewed together always come out even, it being impossible for one to be stretched and the other fulled or gathered; it sews elastic goods well, making a smooth and flexible seam, with stitch alike on both sides, and it is self-adjusting, sewing any number of thicknesses, and operating with equal facility on the thickest and the thinnest goods. But it does more than this: one of its peculiarities, the result of this transference of the feed to the upper surface of the goods, is that it requires no basting, and in hemming, no previous folding and turning in; this feed also enables the operator to turn the work at any angle or curve while the machine is in motion, without changing the tension or length of stitch, and thus it can easily do in a given time more work than any underfeed machine which uses two threads. Its attachments are numerous, and so ingeniously contrived, that there is nothing in the milliner's, dressmaker's, or tailor's trimmings which cannot be produced by them.

We have been thus particular in describing the action of this machine because we regard this vertical feed as a new departure, the development of a new principle, and one which, in some descriptions of work, is an advance on all that have preceded it. In plain sewing it may not be, and probably is not, superior to the Domestic, the Wheeler & Wilson, or the Singer, but in all those branches of work which task the highest skill of the needlewoman, it is an improvement upon them. It is emphatically a ladies' machine, and well adapted for all the lighter kinds of manufacturing; and inasmuch as it can be operated equally as well from the left as from the right side of the needle-bar and feed, we can see no reason why it should not be well adapted to the heavy work of manufacturers.

Among the new machines which have adopted this arrangement of an upper feed, with or without modifications, are: the Manning machine, of Philadelphia, the Post machine, the Rotary Shuttle Sewing Machine, of Foxboro', Mass., and perhaps some others. . The last-named machine has several new ideas which commend it to consideration. Besides its upper feed, which, though having a slightly notched termination, is substantially like that of the Davis, (and the contrivance of the same inventor,) it has also what is called an auxiliary under feed, with a smooth terminal surface, acts either with the upper feed, clamping the material between the two, or independently of it. The upper feed acts only when the needle is *out* of the material. It has also a rotary shuttle, with a round bobbin, which occupies a vertical position and makes a complete revolution with each stitch. This seems to be in some respects similar in its action to the rotary hook of the Wheeler & Wilson machines, though the shuttle first catches and then passes through the loop. The machine is new upon the market, but has impressed the most eminent judges very favorably.

Some of the new machines, like several of the old ones now out of the market, undertake to make the lock stitch, the twisted loop stitch, and the chain stitch. It is undoubtedly possible to do this, and it has been done, by the dextrous management of a skillful expert, even on so stanch and standard a machine as Wheeler & Wilson's No. 1; but the use of it is not so evident. Those who desire the lock stitch do not care for the other kinds, and those who prefer the twisted loop stitch, prefer to have it with all the adjuncts of the Willcox & Gibbs machine, which give it more than half its value.

But while we are recounting what the new machines are doing, or proposing to do, we must not forget that the older companies have not been laggards in the race of improvement. The Singer Company have found time to perfect a modification of their manufacturing machine, intended to work more easily and noiselessly, (their family machine remaining without change,) but so great has been the demand for their present machines, both in their great manufactory in Elizabeth. N. J., and in their extensive works at Glasgow, Scotland, that they have not yet been able to manfacture any of the new machines.

The Wheeler & Wilson Company have added some improvements to their No. 8, a family machine, with overlapping hook, differential disc, straight needle, and independent take-up, which, as the new No. 8 is worthy of all the praise which can be bestowed upon it. They have also produced a new manufacturing machine, No. 10, with a long and high arm, and a rotary shaft, easy-running and not noisy, which, for its purpose, seems to be very nearly perfect. They have also two other machines for special manufacturing purposes, the No. 6 and the Cylinder Machine, which are very well adapted to the work for which they are designed. Other specialties, such as button-hole making, sewing over and over, and shirring, have received their attention. The shirring machine is an ingenious little device, run by hand, and with two peculiarly-formed little needles, which shirrs silk, muslin, cambric, etc., in two parallel lines at any prescribed distance apart, with great rapidity.

The Grover & Baker Company, which was long so popular, has now entirely withdrawn from business, having been merged in the Domestic S. M. Co. The Willcox & Gibbs Company, whose automatic tension has been the wonder and despair of the sewing machine men, have introduced two new adaptations of their machine, one for straw hat sewing, which has proved very popular, the other for the simultaneous sewing and trimming of seams of stockings, shirts, and drawers.

The Weed machine, after varied experiences of light and shadow, have added to their always popular "General Favorite" manufacturing machine, a family machine, as we have already noticed, of the "Domestic" type, but with some improvements, in the way of light-running, stitch-regulating, tension, etc., which are likely to give it a prominent position among the new machines. They have named it the "Hartford."

The "Home" machine, which had at one time a high reputation, has given place to the "New Home," or Johnson, Clark & Co's machine, one of the Domestic type, and this, as well as the White, also a new machine, are rivalling their prototype in the extent of their sales.

Most of the new machines, as well as many of the old ones, have adopted new details, which are real improvements. Among these are the self-setting needle, the loose wheel, automatic bobbin-winder, and extensive nickel plating.

The whole number of machines produced by the various sewing machine companies at their factories here and abroad, (some of them having very extensive manufactories in Europe), in the year 1880, cannot be ascertained with exactness ; but enough is known to make it certain that it ranged between one million and twelve hundred thousand machines, almost ten times as many as had been made in the fourteen years, 1846–1860, before the expiration of Howe's first patent. In this vast production the Singer Co. takes the lead, as it has done since 1868, and probably at its factories on both sides the Atlantic, turns out nearly one-half of all the machines made; the Wheeler & Wilson produced about 100,000, the Domestic, New Home, and White followed with nearly 90,000 each, and the other companies, to the number of nearly sixty in all, ranged from 50,000 down to 1,500 each. By another year, or within three or five years, the figures for the third, fourth, and fifth places may be changed, some of the newer aspirants for fame taking the lead. The grand total of production to the close of 1880 considerably exceeds 10,000,000 machines. It was about 5,800,000 at the close of 1875.

There have also been sewing machines made for special kinds of work, which, though not adapted to the general purposes of sewing, are yet very important members of the sewing machine family.

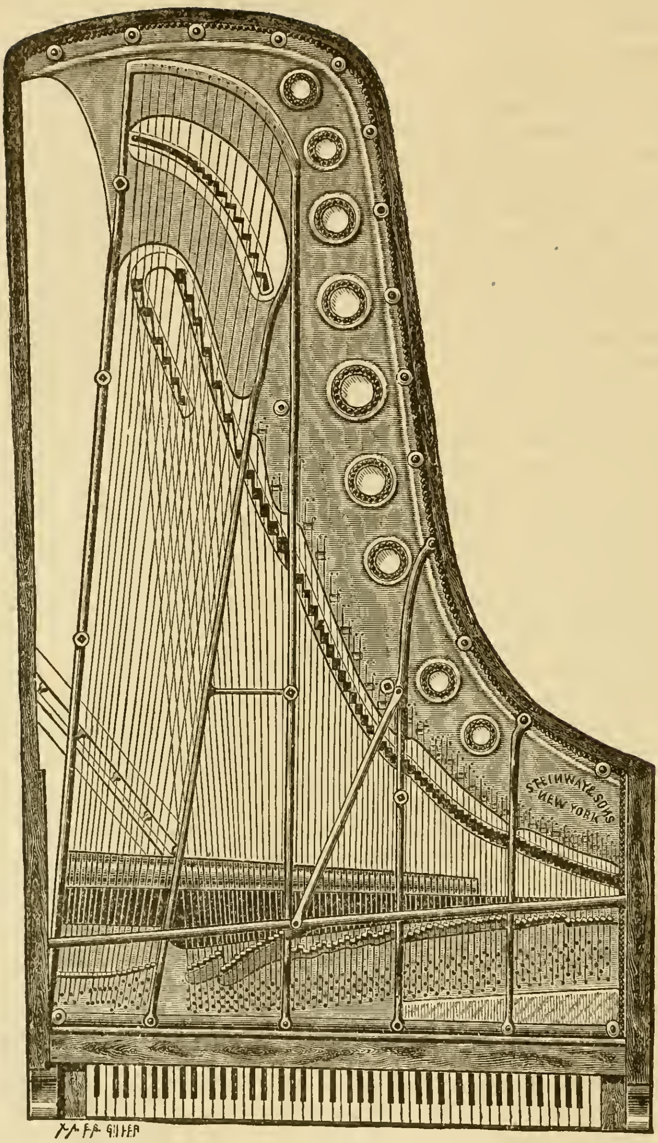
Among these, there are several classes especially deserving of notice. First, the *Button-Hole Machines.* At a very early period it was seen that in order to complete, by machinery, the work of manufacturing clothing, it was necessary that there should be machines or attachments which could make button-holes; inasmuch as the use of the button and button-hole, had been declared by an eminent philosopher, the most complete test of civilization, the savage always using strings, instead of buttons and button-holes. The button-hole stitch did not present any serious difficulties to the men who had invented sewing machines, and before long there were several button-hole attachments placed on the market; some of these worked very well, making a fairly-stitched button-hole, and even ornamenting, with the button-hole stitch (a pretty embroidery stitch), the edges of cloth gaiters and other articles of dress; others were less successful; the button-hole stitches being too far apart. But there was one defect common to them all; while the best made very good stitches, none could make what was known as the *eye* of the button-hole, a round termination of the button-hole at the end where the button strained upon the button-hole. This was necessary in all woolen and leather goods for the more ready buttoning of the garment, and for the greater durability of the button-hole. It seems to be settled that button-holes with eyes can only be produced by a separate machine; that peculiarly-shaped cams and slides, which only come into action when needed, must guide the needle in the formation of this *button-hole eye.* Two machines have been invented which perform the work successfully, one of them the property of the Singer Co., and called by their name, though not invented by their mechanicians. This machine, we believe, is not sold, but rented at a nominal sum to the manufacturers of clothing who pay a small royalty for every dozen button-holes made. It does its work admirably. The other is made by the American Button Hole and Sewing Machine Co., and also make a good button-hole, but we have no means of knowing what are their arrangements with the manufacturers.

The stitching of the uppers of shoes and boots with silk or thread, has been well performed by several of the regular sewing machines. The manufacturing machines of Singer, Howe, Weed, Wheeler & Wilson and some others, have been especially liked for this work. But sewing with waxed threads has been attempted, many times, by the most ingenious mechanicians of our times; but until 1880, without success, except in the sole-sewing machine of McKay and Blake. Of that machine we will speak presently. In 1877, a company which had been experimenting for two years with the French waxed thread machine of Hurter & Hautin, finally despairing of success with it, as, in practice, it seemed rather an oiled thread than a waxed thread machine, employed Mr. S. W. Wardwell, Jr., an eminent inventor, to modify that machine, or invent one which should accomplish the work well. After three years of hard work, Mr. Wardwell perfected a machine, which meets with general approbation, and is likely to prove a great boon to leather workers. It is intended for harness making, the sewing of the seams of light and heavy boots, leather hose and belting, single and double. The difficulties in the way have been, that the wax would adhere to and clog the needle. The upper thread in the eye-pointed needle would catch upon the loop from the shuttle, or the shuttle thread would catch, and there would be constant delays, breaking of threads and needles, and imperfect work. Mr. Wardwell's contrivances warm the thread so as to keep the wax flexible by means of a steam or hot water chest and pipes in its whole course; prevent the loop from touching the needle or shuttle, bring the two threads home firmly and closely, and penetrating the material with an awl from below, just in the track of the needle, secure the filling of this awl-hole perfectly by the thread, prevent any skipping of stitches or imperfect work, and do the work rapidly and elegantly. What the McKay Sole sewing machine was to the shoe manufacture, this machine seems destined to be to all descriptions of leather work requiring waxed threads. The company retain the name of the Hautin Sewing Machine Co., and their factory is at Woonsocket, R. I.

The McKay Sole Sewing Machine Co., whose patent expired in August, 1881, has been already described at some length under the head of "Leather Manufactures." It kept the waxed thread warm and flexible by means of an alcohol lamp in a horn which was a part of the machine and was thrust into the shoe or boot. The machine revolutionized the shoe trade, and its owners received in royalties and rent during the existence of the patent more than $10,000,000.

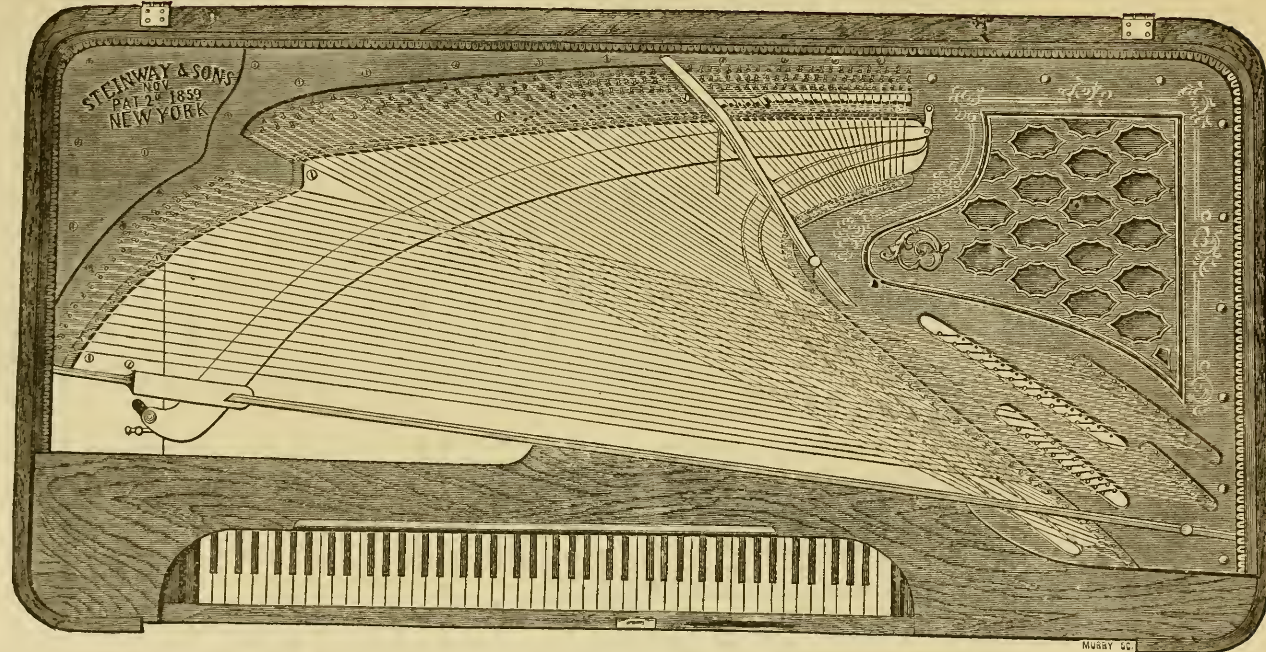
Among other machines for special purposes, we may name the Cylinder machines for sewing seams on sleeves, trousers, bootlegs, leather buckets, hose, etc.; the carpet-making machines, which have never come into very general use; the machines for making the patent ruffling, seam-sewing machines for knit underclothing, straw-sewing machines and book-sewing machines (one of which, said to be more perfect and rapid than any previous one, was invented in 1881); but lack of space forbids our going into details concerning them.

If any apology is needed for the space already occupied, it may be found in the fact that the humble and imperfect machine, which so nearly ruined its inventor, thirty-six years ago, and which has really had a practical existence of not more than thirty years, has, in that time, been introduced in every civilized land, and into the humblest and poorest homes, as well as the palaces of the rich; it has drawn from the public more than three hundred millions of dollars, while its influence and the extent of its sales is constantly increasing. It is, in all respects, an American invention; and when we remember what it has already accomplished for the benefit of humanity, and what are to be its beneficent results in the near future, we feel justified in regarding it as the most valuable boon which American inventive genius has yet bestowed upon the world.




OVERSTRUNG SCALE FOR GRAND PIANOS, INVENTED BY STEINWAY & SONS.

Showing the construction of the Patent Iron Cupola and Pier Frame, with its braces, the fan-like disposition of the strings, and sound-board ring-bridges; the patent resonator; the patent duplex scale, and the patented design of the iron frame with its ornaments and fastenings.




OVERSTRUNG SCALE FOR SQUARE GRAND PIANOS—INVENTED BY STEINWAY & SONS.

SHOWING CONSTRUCTION OF IRON FRAME. DISPOSITION OF THE STRINGS, PATENT AGRAFFE ARRANGEMENT THROUGHOUT, AND THE DUPLEX SCALE AS APPLIED TO THE TREBLE.

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☞ The first Piano constructed with this Overstrung Scale was exhibited by Steinway & Sons at the American Institute Fair, at the Crystal Palace, New York, in 1855, and was unanimously awarded the First Prize, a Gold Medal.

# MUSICAL INSTRUMENTS.

Passing over the class of band instruments, the violin and its congeners, the flute, guitar and harp, all of which, though manufactured here, are substantially the same as European instruments, and none of them have been materially improved, we have only space to speak of the piano and the class of reed instruments. The church organ might indeed challenge our attention, but this has only kept pace with the foreign instrument in its improvements.

The piano has been improved in compass, tone and ability to imitate the musical sounds of the human voice, during the past eighty years, more than any other musical instrument; and most of these improvements have originated in the United States. The instrument in its earliest history was a development of the old *clavichordium*, a German invention dating about 1500, and first described in 1511. It was a very imperfect affair for the next three hundred years, and the principal improvements made in it and connected with its change of name to piano-forte, were made in Germany in the 18th century by Christian Gottlieb Schroeder, a native of Saxony (1699–1784,) and Henry Pape of Wurtemberg, the ancestor of a long line of eminent pianists. The German instruments were the best as late as the beginning of the present century, but they were poor and wiry in tone, and were tolerated rather than admired. Between 1790 and 1810, several important improvements were made in the piano by Broadwood, Southwell, and Stodart, English manufacturers. These improvements were for the most part in the action, and in the compass of the instrument, which at first was only four or five octaves, but has been increased to seven, seven-and-a-half, or eight.

The general principle of all piano-fortes is the same, but there are very great differences of detail in the actions of different makers. The making of pianos is divided into four departments:—1st. The framing and sound board; 2d. The stringing; 3d. The keys and action; 4th. The case, whether ornamental or plain. The frame was originally of hard wood, but of late years is made of iron, very strong, of few parts and securely bolted or screwed together, or, as is the American plan, cast in one piece, to resist the severe tension of the strings. Some manufacturers isolate the frame, in bedding it in the case, by causing it to rest on rubber or other elastic supports. At suitable distances along this frame, and usually arranged in a harp-like form, are pins or studs of metal projecting directly from the metallic frame. To these pins or studs the strings, of steel or brass wire, some of them wound with soft iron, others with copper or silver wire, are attached, each wire being bent about it; the wires are of course of different lengths, and stretched across one or two elevated bridges or supports, to increase and divide their vibratory power. Beneath the strings is the sounding board, originally made of a single thin, carefully-prepared board, so held in place that the middle portion is left free to vibrate. Among the American improvements on the sounding board, one is that of making it double, so as to form a second chamber, the ends only being secured; another manufacturer forms it of thin veneers of different woods, the grain running in different ways, to secure a greater resonance and the vibratory force of each.

The action of the piano consists of a series of small hammers so arranged that by the pressure of the finger upon the keys of the key-board, the hammer corresponding to the key is made to strike the string and cause it to vibrate with a certain, ascertained force. The tone thus produced would be too wiry and metallic if not softened by the interposition of leathers, cloth, felt, or other substance, which mellows and sweetens it. The case may be more or less ornamental, according to the desire of the purchaser, but it has nothing to do with the musical qualities of the instrument. As will be readily perceived, there is a wide field for modifications of detail, and these have been abundantly tried. Till about twenty-five years since, a considerable number of English, French, and German pianos were annually imported, but now American pianos not only supply our own market, but the two International Exhibitions of 1862 and 1867 fully demonstrated their superiority, in many particulars, to those of the best European manufacturers.

We can only briefly review the progress of this manufacture in the United States. Early in the present century, attempts were made to manufacture pianos here by Osborn, by J. Thurston, and by Stodart, a son of the piano-maker of that name in London. But it was reserved for an American-born citizen, by his assiduous labors and inventive genius, to make the piano-forte a source of delight to hundreds of thousands of his countrymen. In 1823, Jonas Chickering, a young mechanic from New Hampshire, commenced their manufacture in Boston, and possessing mechanical ingenuity as well as musical skill, he soon began to improve the instrument. He made the entire frame of iron, in order to enable it to resist the better the immense strain of the tense strings, and at the same time to increase the resonance and purity of its tones. He also devised the "circular scale," with the "arch-wrest planks," or "tuning blocks;" both these improvements were speedily adopted by other manufacturers in Europe and America. His other improvements, which have been numerous, have given his instruments the highest reputation. Other manufacturers have invented valuable modifications and additions to the instrument, but to Mr. Chickering must be accorded the honor of having given that impulse to the business and maintained that position which makes American pianos today the best in the world. Among the improvements introduced by other piano-makers, have been the Æolian attachment of Obed Coleman; the adoption by several manufacturers of the over-strung bass in square pianos; the bedding or insulation of the iron frame by Mr. F. C. Lighte; the use of soft elastic washers to soften the tone, by the same manufacturer; the double sound-board of Mr. S. B. Driggs, intended to increase the volume and sweetness of the tones of the instrument; the bell-metal bridge of Messrs. George Steck & Co., and their method of constructing their boudoir or upright piano; the patent combination sounding-board of Messrs. Raven & Bacon, and the cycloid form of the piano of Messrs. Lindemann & Sons, having the same purpose. Messrs. Steinway & Sons have applied the patent Agraffe arrangement directly to the full iron frame, and have also obviated the difficulties which had been experienced in the construction of the upright piano, by their patent resonator, and double iron frame. Their instruments took the highest premium over the competing pianos of the best manufacturers of Europe, at the International Exhibition in London, in 1862. Both their instruments and Chickering's have a very high reputation in Europe, and in the Paris Exposition of 1867, both received the highest premium. The Steck, Knabe, Weber, Decker, Stodart, Bradbury, and Hallet, Davis & Co. pianos, as well as some others, are also excellent instruments, and some of them are thought to surpass the great manufacturers in their square and boudoir pianos. The Chickerings have made over 55,000 pianos, a larger number than any other manufacturers. The entire production of these instruments is probably not far from 50,000 per annum.

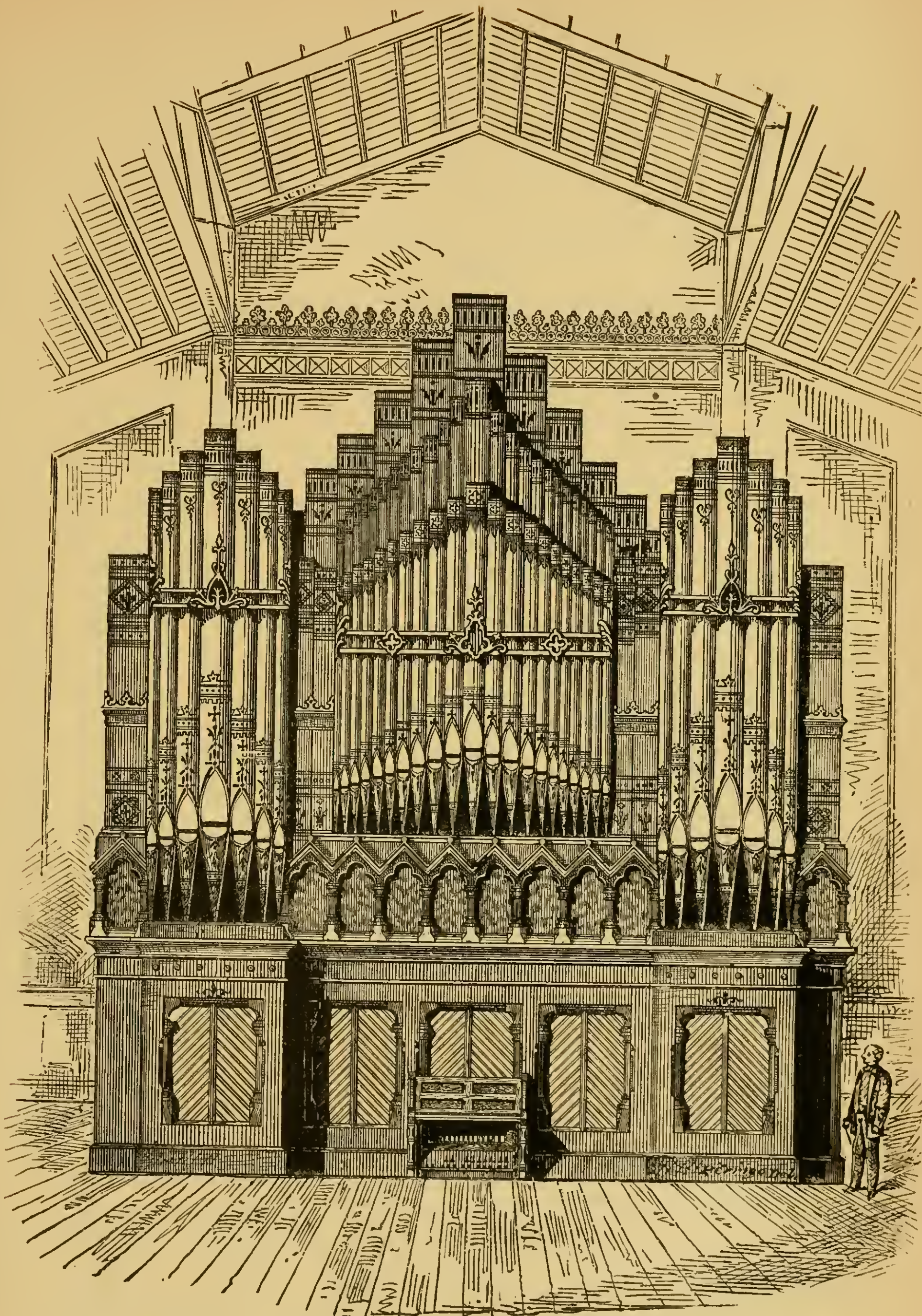
## REED INSTRUMENTS.

THESE are all the inventions of the present century. The first use of metallic reeds (vibrating tongues of metal,) for musical purposes, in Europe or America, was the *Eolodicon* of Eschenberg, of Bohemia, invented about 1810. This was followed, in 1821, by the accordeon, which, whether of small or large size, was little more that a musical toy. The rocking melodeon, as at first constructed, was only an amplification of this, and as in the English and French melodeons, the air was forced outward through the reeds, in order to produce musical sounds. The reeds, moved by this forced current, frequently caught, or did not vibrate promptly, especially the highest and lowest notes. About the year 1840, some of the rocking or lap melodeons, constructed by several manufacturers on an improved plan, gained considerable reputation. The reeds of these were fastened to, and vibrated in. a small square metallic pipe, which was inserted through the top of the wind-chest, with the points of the reeds downward; the rear ends of the keys resting on the open ends of the metallic pipes, and thus forming the valves. About 1840, another improvement was adopted in the lap melodeons, which gave them a better character of tone, and contributed to their introduction as accompaniments to church music. The reeds were riveted upon a piece of brass swedged or bent so as to form three sides of a square, the edges of which were then inserted in grooves made for them upon the upper side of the wind-chest, directly over the valve mortice; and, in order to bring the point of the reed to vibrate on the inside, the reeds were made to pass through their sockets to the under side, and thus naturally took the form of a double curve, somewhat resembling the letter S. This curving the reeds improved the tone, and on this account was adopted by most of the American manufacturers, though liable to the objection of retarding the promptness of the response of the reeds.

In 1846, Mr. Jeremiah Carhart secured a patent for a certain construction of bellows, with other combinations, to operate the reeds by suction or drawing in, instead of forcing out the air, since known as "the exhaust plan." This invention gave to these instruments an improved quality of tone, greater durability, more simplicity of construction, increased promptness of utterance, uniformity of tones, and an equal distribution of power through the entire scale. The melodeons made on this plan by Carhart, and subsequently by Prince & Co., were at first small, of only one size, having but four octaves of reeds, and extremely plain in style. After two or three years, they were increased in size, extended to 4½ and 5 octaves, and had two sets of reeds. This was about the utmost compass possible for the melodeon. Another improvement, made about 1849, was the change of form of the bellows, the exhauster being placed on the upper side of the reed-board, instead of underneath the bellows; this enabled the performer to operate the bellows more easily. The tones of the instrument still lacked softness and sweetness. This difficulty was remedied, in 1849, by a discovery made by Mr. Emmons Hamlin, now of Mason & Hamlin, but then with Prince & Co. He found that, by slightly twisting each of the already curved reeds, this harshness was overcome, and the tones rendered soft and musical.

In 1855, the firm of Mason & Hamlin, formed the previous year, offered to the public their "*Organ Harmonium*," an instrument having 4 sets of reeds and two manuals of keys. The reeds extended from ccc in the "bourdon" to c''''' in alt, or seven octaves. Two blow-pedals were also attached to it, which enabled the performer to produce effects not hitherto attained by any reed instrument in this country. In 1861, after numerous experiments, Messrs. Mason & Hamlin succeeded in perfecting their "*School Harmonium*," simplifying the construction, but retaining all the good features of the larger instrument. In this instrument, the bellows was first placed vertically. This and the other improvements were soon after adapted to the organ harmonium, which thenceforward became capable of receiving a more elegant form, and, in 1862, was brought out in its present shape, as the "*Cabinet Organ.*" Its history since that time has been one of constant improvement, by which its compass, variety and sweetness of tone have been enhanced, while its rapidity of action enables it to render secular music with fine effect, and to become a formidable rival of the piano. Of these improvements, the chief are, the *Double Bellows;* the improved *Self-adjusting Reed Valves;* the *Automatic Bellows Swell*, an addition of great practical value; the *Sounding* and *Tube Boards*, which increase the resonance of its tones; the *Noiseless Safety Valves*, regulating the pressure and escape of the wind; and the *Improved Combination Register*, which facilitates the drawing and closing of the stops.

The resonant chamber is another valuable addition to these instruments, and by minor improvements they have been with the last fifteen years (to 1881) constantly increasing in the public favor till the present production for home and foreign consumption is not less than 50,000 organs per annum. The great competition in the manufacture has reduced the prices, though not the excellence of the instruments. The Mason & Hamlin Co. still maintain the excellence of their instruments; but Estey & Co., Peloubet, the Silver Tongue, S. D. & H. W. Smith, the Burdett Organ Co., D. F. Beatty, the Shoninger Co., and others all make good and desirable organs.



THE "CENTENNIAL" ORGAN. Built by E. & G. G. Hook & Hastings, Boston, Mass.
32 feet wide; 40 feet high; 4 Manuals, 32-feet Pedals.

## MILLS.

The universal dependence of the human family upon bread as food, has no doubt caused that article to be aptly designated as the "staff of life." It has been made of many substances, but in the American colonies, from the earliest times, Indian corn, wheat, and rye have been the leading if not the only materials. The laborers of Europe have only since comparatively recent dates used grain commonly for bread. The peasants of the south of France for long ages used only chestnuts and similar fruits for the purpose. In Germany, rye forms the native "black bread" made of the grain ground but unbolted. The Scotch use oat-meal and barley for bread. The English use wheat commonly, as is the case now mostly in America. Here, however, the variety and abundance of animal and other food is so great that wheaten bread enters less into the daily diet of the masses than would otherwise be the case. Whatever the grain used, however, milling is the first necessity, and the number and capacity of the mills must always be proportioned to the numbers of the people. We find, therefore, in the returns of the manufacturing industry of the Union for 1850, published by order of Congress, that of the whole value produced, $1,019,106,616, by far the largest item was the products of flour and grist mills. This amounted to $136,056,736, or rather more than 13 per cent. Next to this industry, the highest production was of cottons, the most general material for clothing, and that product reached $65,501,687. The largest mill interest was in the state of New York, where the product was $33,037,021. The census of 1840 gave the number of flour mills in the Union for that year, and if we compare the population and crop of wheat as reported, with the number of flour mills, the results are as follows:—

| | Population. | Wheat Raised. Bush. | No. of Flour Mills. |
|---|---|---|---|
| 1840 | 17,069,453 | 84,823,272 | 4,364 |
| 1850 | 23,191,877 | 100,485,944 | 11,891 |
| 1860 | 31,443,322 | 173,104,024 | 13,868 |
| 1870 | 38,558,371 | 287,745,626 | 22,573 |
| 1880 | 50,152,866 | 480,849,700 | |

In order to get the quantity of wheat floured, it is necessary to deduct from this production the quantity reserved for seed and for other purposes, and what is exported as grain.

From the earliest settlement of the country, flour has been an important article of export, and New York wheat early gained a reputation as well abroad as at home. During the wars of Napoleon, the valley of the Hudson furnished large supplies of flour, and milling was a very profitable business. Water-power was generally used. Mills concentrated where this was to be had advantageously in the neighborhood of good supplies of wheat. The mills of Rochester, New York, where the famous Genesee wheat was floured, were a grand example of well-applied water power. The Baltimore and Richmond city mills acquired great reputation, and of late years St. Louis, Chicago, and Milwaukee have become famous for the excellent quality of their flour, and their flouring mills are of great extent and perfection. The mills at Louisville are also on a grand scale. But the largest and most complete flouring mills in the world, are those in Minneapolis, Minnesota. There are 26 of these, covering a flooring space equal to 24 acres, having 359 pair of stones in actual use, and shipping in 1880 an average of 7,000 barrels of flour a day, or 2,150,269 barrels a year, aside from the large amount reserved for home consumption. These mills all use the "New Process," by which, by means of what is known as the middlings purifier, the gluten and phosphates of the wheat are preserved in the flour; the quality and healthfulness of the product is improved; eight per cent. more flour is obtained from a bushel of wheat, and the spring wheat, to which this process is particularly adapted, yields flour of the best quality.

The process of grinding the grain so as to make the best flour, is one of considerable difficulty, and the grinding apparatus differs in different mills, according to the greater or less proportion of gluten contained in the wheat, the character of flour to be produced, the amount of power at command, and the rapidity with which it is desired effect the grinding. The mill stones which are most generally used are known as French burr-stones, and are silicious stones of peculiar quality of which the best are from La Ferté Sous Jouarre, in the Paris basin—though very good mill stones of a different quality are found at Andernache, on the Rhine. Burr-stones are found also near Savannah, Ga., in Arkansas, and at other points in this country;

but they are thought to be inferior to the French. For some years it was believed that the larger the size of the millstones the better the flour which could be produced from them, and they were procured from four to six feet in diameter and weighing from 14 to 16 cwt. These were enormously expensive, and were generally built up of fragments cemented together. The surfaces were generally level but grooved, the direction and course of the grooves being mathematically determined. This grooving is common to millstones of all sizes. It was found that where the wheat contained a large percentage of gluten the millstones became easily clogged, and required a great expenditure of power to move them even slowly, while if rapid movement was attempted, the millstone would fly in pieces, to the destruction of life and property. The stones required also constant adjustment. At first the upper stone was the one which moved, while the lower was fixed; but it was found better to have the upper fixed and the lower move; then the lower was made conical, or at least the frustrum of a cone. Finally it was discovered that smaller millstones did their work much more perfectly, with far less danger and with less expenditure of power and money. Stones not exceeding twenty inches in diameter and weighing not over 170 pounds, yield the best product and require only four or five horsepower to drive them. The Pesth Walz Muhl, the finest flouring mill on the continent of Europe, dispenses with millstones altogether and grinds or crushes the wheat between grooved steel rollers (the hardest steel being used), the grooves being parallel to the axis of the rollers, and the set of rollers being three pairs in number, placed at some distance apart, and six or seven sets being required to complete the process. We are not aware that this method of grinding has been introduced here at least on a large scale.

The products of the grinding (the wheat having been subjected to the cleaning process in the smut and decorticating machines), are groats or grits, the coarser portion of the gluten, flour of different grades from the very finest to middlings and bran. The loss is about 3 per cent in the best mills, and consists of silica, dirt, the awns or vegetable hairs, at the prow or smaller end of the grain, &c. The bran or scales which are mostly composed of the cortical portion of the grain should not exceed 18 per cent., and the other 79 per cent. should consist in the proportions of 45 and 34 per cent. of extra flour and common or medium flour. The groats or grits pass through the grinding process a second time and are mingled with the best flour, or in some instances are packed by themselves as wheaten grits. They constitute the most nutritive portion of the wheat. The extra white A 1. pastry flour is really the least nutritious portion of the grain, being composed almost entirely of the starch and its associated albuminoids.

| Year. | Flour Mills. | Capital Invested. | Production. |
|---|---|---|---|
| 1850 | 11,891 | $54,415,581 | $136,056,736 |
| 1860 | 13,868 | 84,585,004 | 248,580,365 |
| 1870 | 22,573 | 151,565,376 | 444,985,143 |
| 1880 | | | |

The following table shows the production, in quantity and value, of wheat by decades, and the quantity and value of exports of wheat and flour for the same periods:

| Decades. | Wheat Production. Bushels. | Wheat Production Values. Dollars. | Wheat Export. Bushels. | Flour Export. Barrels. | Wheat and Flour Reduced to Wheat. Bushels. | Wheat and Flour Export Values. Dollars. |
|---|---|---|---|---|---|---|
| 1830–1840 | 395,783,638 | 454,151,184 | 2,456,986 | 9,334,896 | 49,131,466 | 59,134,033 |
| 1840–1850 | 926,596,080 | 1,019,256,688 | 13,131,506 | 18,559,525 | 105,929,131 | 116,133,775 |
| 1850–1860 | 1,367,954,340 | 1,400,853,781 | 55,255,528 | 28,927,786 | 199,894,458 | 255,172,346 |
| 1860–1870 | 1,831,236,833 | 2,610,247,593 | 220,115,271 | 31,212,518 | 376,177,861 | 521,426,460 |
| 1870–1880 | 3,602,277,118 | 3,345,641,456 | 667,935,801 | 39,665,327 | 866,262,436 | 1,080,673,035 |

The statistics of production and value of the first three decades are estimates, but represent very nearly the actual production. The export statistics are from the Treasury reports.

But wheat flour and wheat are not and never have been the only breadstuffs exported, as by a reference to the chapters on agriculture, it will be seen that they are not even the most important of our cereal products. But we are speaking here of flouring mills and their products, and so must confine ourselves to these. We exported in the last decade, 1870–1880, over

3,500,000 barrels of Indian meal, worth about $12,300,000. We also exported 537,000,000 bushels of Indian corn, most of which would be ground on the other side of the Ocean. The corn represents a production of 12,268,210,440 bushels—of a value of $5,061,354,552. The barrels of meal exported represent a production of about 28,000,000 barrels, worth not far from $98,000,000. We also exported about 122,000 barrels of rye flour, worth about $707,000. This would indicate the production of at least 1,000,000 barrels of rye flour and meal during the decade, worth about $6,100,000.

There are also other food products from the cereals, of which probably corn starch, maizena, farina, oat meal, wheaten grits, rolled, cracked and pearl wheat, and pearl barley, in their order, are the principal. We have no means of ascertaining the quantity of these produced, but the value of our exports of them in the last decade was about $9,100,000, and this would indicate the value of the entire products as not less than $75,000,000. The manufacture of buckwheat flour has also attained considerable magnitude.

# FURNITURE.

## CHAPTER I.

The use of furniture is one of the marks of a high civilization, and when the articles of need or luxury which come under that name, have assumed forms of artistic beauty, which commend themselves to a cultivated and refined taste, alike in their conception and execution, the highest condition of physical culture may be said to have been attained. The savage tribes of our own and other countries had but little use for anything in the way of furniture. The tent—usually of skins—the hut or booth, of logs, bark, or oftener of branches of trees,—or the cave or excavation in the hillside — constituted their dwelling. If they were nomadic, it was the tent or tepeé with its poles and covering of skins, which was their resting-place, and this when taken down was conveyed from one point to another on the backs of Indian ponies, donkeys, or mules, or among the Northern tribes on the dog sledges—or in default of these on the shoulders of the squaws. The furniture of the tepeé was very slight. There were no seats, for the Indian squatted on the ground; there were no beds, for he lay on the skins of wild beasts, or the boughs of the fragrant pine; there were no wash-bowls or basins, for he never washed; a gourd or a leaf cup answered for drinking purposes when he did not bow down and lap the water from the brook; and this was only necessary when he could not obtain the potent fire-water. His meat, his principal food, whether the flesh of the buffalo, the antelope, the horse, the Rocky Mountain sheep—the deer or elk, was never cooked as we cook it, but either eaten raw or slightly scorched by being held to the fire on the point of a sharp stick. When he deigned to eat vegetables, the corn, or yams, or artichokes were roasted in the ashes. His garments were few, and made of skins, either dressed in their rude way, or with the hair or fur on, and these were worn for a lifetime. The Indians who dwelt in towns, Pueblos, as they are called at the West, had in their rude huts of clay or adobe, some furniture. There were seats, made either of logs or adobe. There were some attempts at bedsteads,—terraces or benches, covered with skins, and they were adepts in some forms of pottery, drinking vessels, water jars, and the like. They spun and wove from the numerous textiles around them, and the wool of their sheep, some garments of rather tasteful forms, and produced from the gold and silver which abounded in the hills, ornaments for the wrists, ankles, neck, breasts, ears, lips, and nose, which generally bore some resemblance to animals with whose forms they were familiar. These articles of furniture or display, however, cost them dear as they were, by the greed of the Spanish adventurers taken from them, and they themselves reduced to a cruel slavery in working the mines, from which the precious metals had come. In the settlement of the United States our ancestors, most of whom were in comfortable circumstances for that period, brought with them considerable quantities of furniture, or, as it was then called, household stuffs, to furnish the cabins which formed their first homes. In subsequent years when passengers were not so numerous, the vessels were largely freighted with furniture, many articles of which have since become historic. How many chests of drawers, chairs, tables, bedsteads, and mirrors came over in the Mayflower, we shall never know, but the numbers of those articles which are traced back to that famous little vessel, and which are still in existence, would furnish an ample cargo for the largest of the White Star steamers.

But as the newly arrived immigrants pushed westward through the trackless forests to the Connecticut river and beyond in New England, to the Shenandoah valley in Virginia, to Beaverwyck, and the Mohawk valley in New York, or to similar distances in the other colonies, they found great difficulty in taking much furniture with them, and gradually reduced their imperative necessities almost to the savage standard. They reared rude but moderately comfortable cabins, for church and home, of the logs of the interminable forests; and benches and tables were made from split logs. The pine straw and the balsam and hemlock boughs made fragrant if not luxurious beds, and sometimes bunks or rough bedsteads were hewn out with the axe and heaped up with the boughs and covered with the skins of cattle or wild beasts. The iron pot was a necessity, and that was never missing, but gourds, cocoanut shells, and wooden bowls scooped out with axe or adze, answered for bowls and cups. Rude mortars for pounding the corn were made from stumps of trees, an overhanging limb being spliced with a solid block of wood to form a pounder. When saw mills and grist mills were established, and carpenters, joiners, and cabinent makers began to ply their respective trades, these rough appliances were replaced by those of more convenient construction, though, not till the eighteenth century, of much artistic beauty.

Even up to the time of the revolution, away from the larger towns, it was only in the habitations of the very wealthy who were able to import such furniture as they needed, that anything of elegance in the way of furniture was to be found. The farmers and the country people generally were content to sit on blocks, or on the rough and cumbrous settle by the great kitchen fire. The great table with almost timber enough for a house in it had slab benches without backs around it; wooden trenchers supplied the place of plates, wooden spoons, or sometimes those of horn, were substitutes for silver, and the steel or iron knife and fork were highly prized because they had come from over the water. A wooden bottle contained the cider, beer, or sweetened water, or sometimes the pure spring water which was drawn off in gourds as wanted. The platters as well as the trenchers were of wood. In the best room, kept dark and strewed with rushes, there were some splint-bottomed chairs, a small and generally very imperfect looking glass, perhaps a chest of drawers from over sea, samplers of impossible colors, and designs which reminded one of the Gobelins tapestry by contrast, and if any of the family were musically inclined, a lute, or possibly a fiddle—the spinette, the ancestor of the modern piano, though at a distant remove, was to be found only in the houses of the very rich. The broad fire-place was garnished with branches of asparagus, and, if the family were aesthetically inclined, a few conch shells were arranged on the mantel-piece. Only the rich could afford the luxury of a clock, and very few even of these, were the proud owners of a watch. The noon mark and the position of the sun in the heavens were the indicators of time.



With the creation and revival of manufactures which followed the close of the revolutionary war, the manufacture of furniture became at first a small, but after the years of abject poverty and misery which followed the war, were past, a very considerable industry. The furniture produced by the early cabinet-makers was not always very graceful or artistic, but it had the merit at least of being solid and substantial. The bedsteads, bureaus, tables, and chairs of that period seemed to have been made for, and by, some of the sons of Anak, or the giants of Bashan. We remember well a bedstead of mahogany made for one of the wealthy families of a New England town, not far from 1790, it was said, and which, when finally sold under the hammer, was found to weigh over a ton.

With increasing population and a wide diffusion of wealth, came better grades of furniture, still not artistic, but of a plain and substantial character; the heavy articles of furniture were replaced by those less ponderous; the splint-bottomed chairs gave place to seats of rushes skillfully woven and painted; to these succeeded the more pliable cane or rattan; and in the towns, a few ventured upon upholstered seats. The sofa and later the piano were introduced into houses of the better class. The tall four poster bedstead, except in the best guest chamber, gave place to the lighter and lower post bedstead without hangings. Clocks—Yankee clocks—were found in most houses, and crockery—and rarely China—replaced the wooden trenchers and platters, and silver table and teaspoons, the wooden spoons of the earlier times. The progress of furniture production was rapid, though it did not increase beyond the demand of the incoming population. In an evil day, veneers made their appearance, and very soon all of the ordinary grades of house furniture were made on bases of pine, white wood, or other cheap and soft woods, and veneered to represent the costliest mahogany, or even rosewood. As time drew on, great factories were established in wooded districts, away from the cities, the frame work made, and eventually the larger veneers applied, and then the furniture shipped to the larger towns and cities to be finished up there and sold to dealers in all quarters North, South, East, and West, and even to foreign states, at apparently low prices, as elegant furniture of the latest and best designs. Another device was to enamel and paint the furniture made entirely of these cheap woods, so as to give it a very pretty appearance. Of course, these cheap wares made entirely of pine, paint, putty, and veneer did not last. It was never intended that they should; and the market was all the more brisk because furniture had to be renewed so often. With the increase of labor saving machinery and tools for performing the most delicate work, this trashy furniture has increased and is still increasing its production, and its decorations are often to the careless observer very attractive. Inlaying and the use of lacker, papier maché, and enamels, are resorted to, to make the merest trash appear valuable and salable.

But disgust with this worthless furniture has led to the production of articles of a much higher quality, and some of them of artistic designs and of great beauty. This better class of furniture is made of solid woods, except in upholstered goods, and even in those all the exposed portions are solid; most of it is hand-wrought, and though availing themselves of the best tools, there is no slighting of any part of the work. If carved, the carving is done by a skillful carver, and the furniture, though generally following, rather slavishly, the prevalent European styles, such as the Eastlake, and the less attractive and practical rococo and Louis XIV styles, is really honest and well made.

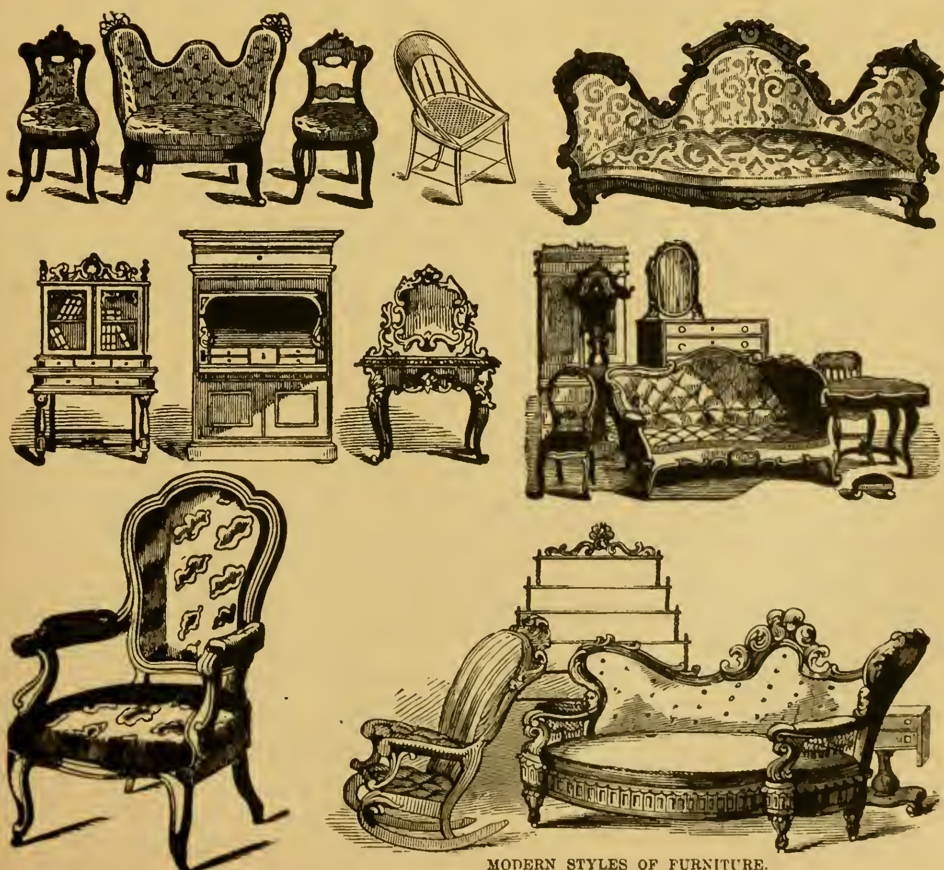
With the introduction of the furniture designer, an artist, whose business it is to make designs for the furniture and belongings of our more stately residences, in harmony with the dwellings themselves and their surroundings, there has come a further advance in the production of furniture which is thoroughly artistic and for the most part of original and American designs. These designs apply not only to the movable furniture, but to the decoration of the walls, the wall papers, if these are used, the carpets, and even the china and the decorations of the dining-room, the silver, and the framing and setting of the pictures, etc., etc.

There is, of course, a great deal of false taste, and often an entire lack of taste, among those who have suddenly become rich, and this leads to great and ludicrous incongruities in furnishing their costly residences; but where they can be persuaded to give up the furnishing and decoration, to a thoroughly honest and competent designer, there are not usually many serious blunders.

The manufacture of furniture has rapidly increased within the past 25 years. In 1860 the census reported an annual production for the year 1859, of not more than 30 millions of dollars in all branches; the census of 1870 reported about 103 millions of dollars in all branches of the business. The statistics of the census of 1880 are not yet ready for publication, but enough is known to make it certain that they will exceed 200 millions.

Of course, much the larger part of this immense sum belongs to the cheaper styles, which take with the million; but there has been nevertheless a very great advance within the last decade in the manufacture of good and artistic furniture, and the demand for it is increasing with equal rapidity.

STYLE OF FURNITURE FIFTY TO ONE HUNDRED YEARS AGO.



MODERN STYLES OF FURNITURE.

KITCHEN OF 1770.

KITCHEN IN 1870.

1776.

EVENING DRESS. 1780.

1780.

1785.

EVENING DRESS. 1795.

EVENING DRESS. 1797.

1800.

1805.

1805.

1812.

1812.

1812.

1815.

1818.

1820.

1825.

1828.

WINTER DRESS. 1833.

1833.

1833.

1833.

1840.

1844.

1850.


FASHIONS FROM 1850 TO 1860.

PLAIN DRESS OF VARIOUS PERIODS. EXTREME FASHIONS OF 1868–9.

MINING CAMP.

# MINING INDUSTRY OF THE UNITED STATES.

## INTRODUCTORY REMARKS.

The mineral wealth of the American colonies does not appear to have been an object of much interest to the early settlers. Congregated near the coast, they were little likely to become acquainted with many of the mineral localities, most of which are in the interior, in regions long occupied by the Indian tribes. The settlers, moreover, probably possessed little knowledge of mining, and certainly lacked capital which they could appropriate in this direction. Some discoveries, however, were made by them very soon after their settlement, the earliest of which were on the James river, in Virginia. Beverly, in his "History of the Present State of Virginia," published in London in 1705, makes mention of iron works which were commenced on Falling Creek, and of glass-houses which were about to be constructed at Jamestown just previous to the great massacre by the Indians, in 1622. This undertaking at Falling Creek is referred to by other historians, as by Stith, in his "History of Virginia" (1753), p. 279. A Captain Nathaniel Butler, it appears, presented to the king, in 1623, a very disparaging account of the condition of the colony, mentioning, among other matters, that "the Iron Works were utterly wasted, and the People dead; the Glass Furnaces at a stand, and in small Hopes of proceeding." The committee of the company, in their reply to this, affirm that "great Sums had been expended, and infinite Care and Diligence bestowed by the Officers and Company for setting forward various Commodities and Manufactures; as Iron Works," etc., etc. Salmon, in his "Modern History" (1746), vol. iii, pp. 439 and 468, refers to the statement of Beverly, mentioning that "an iron work was set up on Falling Creek, in James River, where they found the iron ore good, and had near brought that work to perfection. The iron proved reasonably good; but before they got into the body of the mine, the people were cut off in that fatal massacre (of March, 1622), and the project has never been set on foot since, until of late; but it has not had its full trial." This author also refers to the representations of the Board of Trade to the House of Commons, in 1732, as containing notices of the iron works in operation in New England. From various reports of the governor of Massachusetts Bay and other officials of this colony, there appear to have been, in 1731, as many as six furnaces and nineteen forges for making iron in New England, as also a slitting mill and nail factory connected with it.

The first blast furnace in the colonies appears to have been built in 1702, by Lambert Despard, at the outlet of Mattakeeset pond, in Plymouth County, Massachusetts, and a number more were afterward set in operation to work the bog ores of that district. Their operations are described in the "Collections of the Massachusetts Historical Society" for 1804, by James Thacher, M. D., who was himself engaged in the manufacture. In Rhode Island and Providence Plantations, the same kinds of ore were found and worked at about the same period. Alexander gives the year 1715 as the epoch of blast furnaces in Maryland, Virginia, and Pennsylvania. These enterprises were regarded with great disfavor in the mother country. In 1719 an act was brought forward in the House of Lords, forbidding the erection of rolling or slitting mills in the American colonies, and in 1750 this was made a law.

In Connecticut, Governor Winthrop was much interested in investigating the character of the minerals about Haddam and Middletown. In 1651 he obtained a license giving him almost unlimited privileges for working any mines of "lead, copper, or tin, or any minerals; as antimony, vitriol, black lead, alum, salt, salt springs, or any other the like, * * * to enjoy forever said mines, with the lands, woods, timber, and water within two or three miles of said mines." And in 1661, another special grant was made to him of any mines he might discover in the neighborhood of Middletown. It does not appear, however, that he derived any special advantage from these privileges, although he used to make frequent excursions to the different localities of minerals, especially to the Governor's Ring, a mountain in the north-west corner of East Haddam, and spend three weeks at a time there with his servant, engaged, as told by Governor Trumbull to President Styles, and recorded in his diary, in "roasting ores, assaying metals, and casting gold rings." John Winthrop, F.R.S., grandson of Governor Winthrop, was evidently well acquainted with many localities of different ores in Connecticut, and sent to the Royal Society a considerable collection of specimens he had made. It is supposed that among them Hatchett found the mineral columbite, and detected the new metal which he named columbium. At Middletown, an argentiferous lead mine was worked, it is supposed, at this period, by the Winthrops, and the men employed were evidently skilful miners. When the mine was reopened in 1852, shafts were found well timbered and in good preservation, that had been sunk to the depth of 120 feet, and, with the other workings, amounted in all to 1,500 feet of excavation. The oldest American charter for a mining company was granted in 1709, for working the copper ores at Simsbury, Connecticut. Operations were carried on here for a number of years, the ore raised being shipped to England, and a similar mining enterprise was undertaken in 1719, at Belleville, in New Jersey, about six miles from Jersey City. The products of the so-called Schuyler mine at this place amounted, before the year 1731, to 1,386 tons of ore, all of which were shipped to England. At this period (1732) the Gap mine, in Lancaster county, Pennsylvania, was first opened and worked for copper, and about the middle of the century various other copper mines were opened in New Jersey; also, the lead mine at Southampton, Mass., and the cobalt mine at Chatham, Conn. In 1754 a lead mine was successfully worked in Wythe county, in south-western Virginia, and this is still productive. It is probable that, by reason of the higher value of copper at that period, and the lower price paid for labor than at present, some of the copper mines may have proved profitable to work, though it is certain this has not been the case with them of late years. The existence of copper in the region about Lake Superior was known, from the reports of the Jesuit missionaries, in 1660, and one or two unsuccessful attempts were made to work it during the last century by parties of Englishmen. The lead mines of the upper Mississippi, discovered by Le Sueur in his exploring voyage up the river in 1700 and 1701, were first worked by Dubuque, a French miner, in 1788, upon the tract of land now occupied by the city in Iowa bearing his name.

Such, in general, was the extent to which this branch of industry had been carried up to the close of the last century. The only coal mines worked were some on the James river, twelve miles above Richmond, and the capacity of these for adding to the wealth of the country was not by any means appreciated. The gold mines were entirely unknown, and the dependence of the country upon Great Britain for the supply of iron had so checked the development of this branch of manufacture, that comparatively nothing was known of our own resources in the mines of this metal. The most important establishments for its manufacture were small blast furnaces, working bog ores, and the bloomaries of New York and New Jersey, making bar iron direct from the rich magnetic ores.

The progress of the United States in these branches will be traced in the succeeding chapters, one of which will be devoted to each of the principal metals.

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## CHAPTER I.

### IRON.

The early history of the iron manufacture in the American colonies has been noticed in the introductory remarks which precede this chapter. Since the year 1750 the restrictions imposed upon the business by the mother country had limited the operations to the production of pig iron and castings, and a few blast furnaces were employed in New England and the middle Atlantic states. A considerable portion of the pig iron was exported to Great Britain, where it was admitted free of duty, and articles of wrought iron and steel were returned from that country. In 1771 the shipment of pig iron from the colonies amounted to 7,525 tons. By the sudden cessation of commercial relations on the breaking out of the war, the country was thrown upon its own resources, but was illy prepared to meet the new and extraordinary demands for iron. The skill, experience, and capital for this business were all alike wanting, and even the casting of cannon was an undertaking that few of the furnace masters were prepared to venture upon. The bog ores found in Plymouth county, Mass., together with supplies from New Jersey, sustained ten furnaces; and in Bridgewater, cannon were successfully cast and bored by Hon. Hugh Orr, for the supply of the army. They were also made at Westville, Conn., by Mr. Elijah Backus, who welded together bars of iron for the purpose. The Continental Congress, also, was forced to establish and carry on works for furnishing iron and steel, and in the northern part of New Jersey, the highlands of New York, and the valley of the Housatonic in Connecticut, they found abundance of rich ores, and forests of the best wood for the charcoal required in the manufacture. At their armory at Carlisle, Pa., the first trials of anthracite for manufacturing purposes were made in 1775. But the condition of the country was little favorable for the development of this branch of industry, and after the war, without capital, a currency, or facilities of transportation, the iron business long continued of little more than local importance. The chief supplies were again furnished from the iron works of Great Britain, the establishment of which had in great part been owing to the restrictions placed upon the development of our own resources; and while that country continued to protect their own interest by prohibitory duties that for a long period excluded all foreign competition, the iron interest of the United States languished under a policy that fostered rather the carrying trade between the two countries than the building up of highly important manufactories, and the establishment around them of permanent agricultural settlements through the home market they should secure. Hence it was that the manufacture in Great Britain was rapidly accelerated, improved by new inventions, strengthened by accumulated capital, and sustained by the use of mineral coal for fuel, almost a century before we had learned in the discouraging condition of the art, that this cheap fuel, mines of which were worked near Richmond in Virginia, before 1790, could be advantageously employed in the manufacture. The natural advantages possessed by Great Britain powerfully co-operated with her wise legislation; and as her rich deposits of iron ore and coal were developed in close juxtaposition, and in localities not far removed from the coast, the iron interest became so firmly established that no nation accessible to her ships could successfully engage in the same pursuit, until, by following the example set by Great Britain, its own mines and resources might be in like manner developed. Thus encouraged and supported, the iron interest of Great Britain has prospered at the expense of that of all other nations, till her annual production amounts to more than one-half of the seven millions or eight millions of tons produced throughout the world; and the products of her mines and furnaces have, until quite recently, been better known, even in the extreme western states, where the cost of "Scotch pig iron" has been more than doubled by the transportation, than has that of the rich ores of those very states. And thus it is the annual production of the United States only reached 2,000,000 tons in 1869, notwithstanding the abundance and richness of her mines, both of iron ores and of coal, and the immense demands of iron for her own consumption. So great are the advantages she possesses in the quality of these essential materials in the production of iron, that according to the statement of an able writer upon this subject, who is himself largely engaged in the manufacture, less than half the quantity of raw materials is required in this country to the ton of iron, that is required in Great Britain, "thus economizing labor to an enormous extent. In point of fact, the materials for making a ton of iron can be laid down in the United States at the furnace with less expenditure of human labor than in any part of the known world, with the possible exception of Scotland." ("On the Statistics and Geography of the Production of Iron," by Abram S. Hewitt, N. Y., 1856, p. 20). The tables presented by this writer, of the annual production, show striking vicissitudes in the trade, which is to be accounted for chiefly by the fluctuations in prices in the English market depressing or encouraging our own manufacture, and by the frequent changes in our tariff.

"In 1810 the production of iron, entirely charcoal, was 54,000 tons. In 1820, in consequence of the commercial ruin which swept over the country just before, the business was in a state of comparative ruin, and not over 20,000 tons were produced.

| Year. | Product. | Year. | Product. |
|---|---|---|---|
| 1828,... .... | 130,000 tons. | 1859,........ | 840,427 tons. |
| 1830,........ | 165,000 " | 1860,........ | 913,774 " |
| 1832,........ | 200,000 " | 1862,........ | 787,662 " |
| 1840,........ | 347,000 " | 1863,........ | 947,604 " |
| 1842,........ | 215,000 " | 1864,........ | 1,135,497 " |
| 1845,... .... | 486,000 " | 1866, ....... | 1,350,943 " |
| 1847,........ | 800,000 " | 1867,........ | 1,461,626 " |
| 1852,....... . | 564,000 " | 1869,........ | 1,916,641 " |
| 1855,........ | 754,178 " | 1870,........ | 3 494,650 " |
| 1856,........ | 874 423 " | 1878,........ | 4,132,937 " |
| 1857,........ | 798,157 " | 1880,.... ... | 6,134,269 " |

There was a protective duty on iron from 1825 to 1837, but none from 1837 to 1843. From 1843 to 1848 there was protection, but none from 1848 to 1863. The high protective duty was modified in 1866, and since that time the protection has been more and more moderate as the premium on gold declined. The tariff of 1870 reduced the duty from nine to seven dollars per ton on pig iron, and from eight to six dollars per ton on scrap iron, but the amount of capital put in the business was so large, and the facilities for manufacture were so great, that it has gone on increasing, notwithstanding the reduction in the tariff, till we are in a position to supply the greater part of our demand. The capital invested in the manufacture of iron and steel in this country, in 1870, was $121,772,074, a very great advance on the previous decade. In 1880, the capital invested was $230,971,884, an increase in the decade of $109,199,810, or 89.68 per cent.

Until the year 1840, charcoal had been the only fuel used in the manufacture of iron; and while it produced a metal far superior in quality to that made with coke, the great demands of the trade were for cheap irons, and the market was chiefly supplied with these from Great Britain. The introduction of anthracite for smelting iron ores, in 1840, marked a new era in the manufacture, though its influence was not sensibly felt for several years.

MATERIALS EMPLOYED IN THE MANUFACTURE

Before attempting to exhibit the resources of the United States for making iron, and the methods of conducting the manufacture, it is well to give some account of the materials employed, and explain the conditions upon which this manufacture depends. Three elements are essential in the great branch of the business—that of producing pig iron. viz., ores, fuel to reduce them, and a suitable flux to aid the process by melting with and removing the earthy impurities of the ore in a freely-flowing glassy cinder. The flux is usually limestone, and by a wise provision, evidently in view of the uses to which this would be applied, limestone is almost universally found conveniently near to iron ores; so also are stores of fuel commensurate with the abundance of the ores.

The principal ores are hematites, magnetic, and specular ores, the red oxides of the secondary rocks, and the carbonates. Probably more than three-quarters of the iron made in the United States is from the first three varieties named, and a much larger proportion of the English iron is from the last—from the magnetic and specular ores none. Hematites, wherever known, are favorite ores. They are met with in great irregular-shaped deposits (apparently derived from other forms in which the iron was distributed), intermixed with ochres, clays, and sands, sometimes in scattered lumps and blocks, and sometimes in massive ledges; they also occur in beds interstratified among the mica slates. Although the deposits are regarded as of limited capacity, they are often worked to the depth of more than 100 feet; in one instance, in Berks county, Penn., to 165 feet. Mines of hematite have proved the most valuable mines in the United States. At Salisbury, in Connecticut, they have been worked almost uninterruptedly for more than 100 years, supplying the means for supporting an active industry in the country around, and enriching generation after generation of proprietors. The great group of mines at Chestnut Hill, in Columbia county, Penn., and others in Berks and Lehigh counties in the same state are of similar character, as are many of the deposits in the western states, some of them not yet worked to any considerable extent. In Colorado, Utah, Montana, Oregon, and Washington Territory there are extensive deposits of hematite ores, as well as of magnetic and specular ores.

The ore is a hydrated peroxide of iron, consisting of from 72 to 85 per cent. of peroxide of iron (which corresponds to about 50 to 60 per cent. of iron), and from 10 to 14 per cent. of water. Silica and alumina, phosphoric acid, and peroxide of manganese are one or more present in very small quantities; but the impurities are rarely such as to interfere with the production of very excellent iron, either for foundry or forge purposes—that is, for castings or bar iron. It is easily and cheaply mined, and works easily in the blast furnace. On account of its deficiency in silica it is necessary to use a limestone containing this ingredient, that the elements of a glassy cinder may be provided, which is the first requisite in smelting iron; or the same end may be more advantageously attained by adding a portion of magnetic ore, which is almost always mixed with silica in the form of quartz; and these two ores are consequently very generally worked together—the hematites making two-thirds or three-quarters of the charge, and the magnetic ores the remainder.

Magnetic ore is the richest possible combination of iron, the proportion of which cannot exceed 72.4 per cent., combined with 27.6 per cent of oxygen. It is a heavy, black ore, compact or in coarse crystalline grains, and commonly mixed with quartz and other minerals. It affects the magnetic needle, and pieces of it often support small bits of iron, as nails. Such ore is the loadstone. It is obtained of various qualities; some sorts work with great difficulty in the blast furnace, and others are more easily managed and make excellent iron for any use; but all do better mixed with hematite. The magnetic ores have been largely employed in the ancient processes of making malleable iron direct from the ore in the open forge, the Catalan forge, etc., and at the present time they are so used in the bloomary fires. They are found in inexhaustible beds of all dimensions lying among the micaceous slates and gneiss rocks. These beds are sometimes so extensive that they appear to make up the greater part of the mountains in which they lie, and in common language the mountains are said to be all ore.

Specular ore, or specular iron, is so named from the shining, mirror-like plates in which it is often found. The common ore is sometimes red, steel gray, or iron black, and all these varieties are distinguished by the bright red color of the powder of the ore, which is that of peroxide of iron. Magnetic ore gives a black powder, which is that of a less oxidized combination. The specular ore thus contains less iron and more oxygen than the magnetic; the proportions of its ingredients are 70 parts in 100 of iron, and 30 of oxygen. Though the difference seems slight, the qualities of the two ores are quite distinct. The peroxide makes iron fast, but some sorts of it produce an inferior quality of iron to that from the hematite and magnetic ores, and better adapted for castings than for converting into malleable iron. The pure, rich ores, however, are many of them unsurpassed. It is found in beds of all dimensions, and though in the eastern part of the United States they prove of limited extent, those of Missouri and Lake Superior are inexhaustible. Magnetic and specular ores are associated together in the same district, and sometimes are accompanied by hematite beds; and it is also the case, that iron districts are characterized by the prevalence of one kind only of these ores, to the exclusion of the others.

The red oxides of the secondary rocks consist, for the most part, of the red fossiliferous and oolitic ores that accompany the so-called Clinton group of calcareous shales, sandstones, and argillaceous limestones of the upper silurian along their lines of outcrop in Pennsylvania, Maryland, and eastern Tennessee, and from Oneida county, N. Y., westward past Niagara Falls, and through Canada even to Wisconsin. The ore is found in one or two bands, rarely more than one or two feet thick, and the sandstone strata with which they are associated are sometimes so ferruginous as to be themselves workable ores. The true ores are sometimes entirely made up of the forms of fossil marine shells, the original material of which has been gradually replaced by peroxide of iron. The oolitic variety is composed of fine globular particles, united together like the roe of a fish. The ore is also found in compact forms, and in Wisconsin it is in the condition of fine sand or seed. Its composition is very variable, and its per-centage of iron ranges from 40 to 60. By reason of the carbonate of lime diffused through some of the varieties, these work in the blast furnace very freely, and serve extremely well to mix with the silicious ores.

Of the varieties of carbonate of iron, the only ones of practical importance in the United States are the silicious and argillaceous carbonates of the coal formation, and the similar ores of purer character found among the tertiary clays on the western shores of Chesapeake Bay. The former varieties are the chief dependence of the iron furnaces of Great Britain, where they abundantly occur in layers among the shales of the coal formation, interstratified with the beds of coal—the shafts that are sunk for the exploration of one also penetrating beds of the other. The layers of ore are in flattened blocks, balls, and kidney-shaped lumps, which are picked out from the shales as the beds of these are excavated. The ore is lean, affording from 30 to 40 per cent. of iron; but it is of easy reduction, and makes, when properly treated, iron of fair quality. In Pennsylvania, Ohio, western Virginia, Kentucky, and Tennessee, the ores occur with the same associations as in England; but the supply is, for the most part, very precarious, and many furnaces that have depended upon them are now kept in operation only by drawing a considerable portion of their supplies from the mines of Lake Superior, more than one thousand miles off. Among the horizontally stratified rocks west of the Alleghanies, the same bands of ore are traced over extensive districts, and are even recognized in several of the different states named. One of the most important of these bands is the buhrstone ore, so called from a cellular, flinty accompaniment which usually underlies it, the whole contained in a bed of peculiar fossiliferous limestone. So much carbonate of lime is sometimes present in the ore, that it requires no other flux in the blast furnace. Its per-centage of iron is from 25 to 35. Along the line of outcrop of some of the carbonates are found deposits of hematite ores, the result of superficial changes in the former, due to atmospheric agencies long continued. In southern Ohio, at Hanging Rock particularly, numerous furnaces have been supported by these ores, and have furnished much of the best iron produced at the west.

The carbonates of the tertiary are found in blocks and lumps among the clays along the shores of the Chesapeake at Baltimore, and its vicinity. The ores are of excellent character, work easily in the furnace, make a kind of iron highly esteemed—particularly for the manufacture of nails—and are so abundant that they have long sustained a considerable number of furnaces. They lie near the surface, and are collected by excavating the clay beds and sorting out the balls of ore. The excavations have been carried out in some places on the shore below the level of tide, the water being kept back by coffer dams and steam pumps.

Bog ores, with which the earliest furnaces in the country were supplied, are now little used. They are rarely found in quantities sufficient for running the large furnaces of the present day, and, moreover, make but an inferior, brittle quality of cast iron. They are chiefly found near the coast, and being easily dug, and also reduced to metal with great facility, they proved very convenient for temporary use before the great bodies of ore in the interior were reached. Some furnaces are still running on these ores in the south-west part of New Jersey, and at Snowhill, on the eastern shore of Maryland, and the iron they make is used to advantage in mixing at the great stove foundries in Albany and Troy with other varieties of cast iron. It increases the fluidity of these, and produces with them a mixture that will flow into and take the forms of the minutest markings of the mould.

Charcoal has been the only fuel employed in the manufacture of iron until anthracite was applied to this purpose, about the year 1840, and still later—in the United States—coke and bituminous coal. So long as wood continued abundant in the iron districts, it was preferred to the mineral fuel, as in the early experience of the use of the latter the quality of the iron it produced was inferior to that made from the same ores with charcoal, and even at the present time, most of the highest-priced irons are made with charcoal. The hard woods make the best coal, and after these, the yellow pine. Hemlock and chestnut are largely used, because of their abundance and cheapness. The charcoal furnaces are of small size compared with those using the denser mineral coal, and their capacity rarely exceeds a production of ten or twelve tons of pig iron in twenty-four hours. In 1840 they seldom made more than four tons a day; the difference is owing to larger furnaces, the use of hot blast, and much more efficient blowing machinery. The consumption of charcoal to the ton of iron is one hundred bushels of hard-wood coal at a minimum, and from this running up to one hundred and fifty bushels or more, according to the quality of the coal and the skill of the manager. The economy of the business depends, in great part, upon the convenience of the supplies of fuel and of ores, of each of which rather more than two tons weight are consumed to every ton of pig iron. As the woods are cut off in the vicinity of the furnaces, the supplies are gradually drawn from greater distances, till at last they are sometimes hauled from ten to fourteen miles. The furnaces near Baltimore have been supplied with pine wood discharged from vessels at the coaling kilns close by the furnaces. Transportation of the fuel in such cases is a matter of secondary importance.

The mineral coals are a more certain dependence in this manufacture, and are cheaply conveyed from the mines on the great lines of transportation, so that furnaces may be placed anywhere upon these lines, with reference more especially to proximity of ores. Thus they can be grouped together in greater numbers than is practicable with charcoal furnaces. Their establishment, however, involves the outlay of much capital, for the anthracite furnaces are all built upon a large scale, with a capacity of producing from twenty to sixty tons of pig iron a day. This requires machinery of great power to furnish the immense quantities of air, amounting in the large stacks to fifteen tons or more every hour, and propel it through the dense column, of fifty to sixty feet in height, of heavy materials that fill the furnace. The air actually exceeds in weight all the other materials introduced into the furnace, and its efficiency in promoting combustion and generating intensity of heat is greatly increased by the concentration to which it is subjected when blown in under a pressure of six or eight pounds to the square inch. It is rendered still more efficient by being heated to temperature sufficient to melt lead before it is introduced into the furnace; and this demands the construction of heating ovens, through which the blast is forced from the blowing cylinders in a series of iron pipes, arranged so as to absorb as much as possible of the waste heat from the combustible gases that issue from the top of the stack, and are led through these ovens before they are finally allowed to escape. The weight of anthracite consumed is not far from double that of the iron made, and the ores usually exceed in weight the fuel. The flux is a small and cheap item, its weight ranging from one-eighth to one-third that of the ores.

The location of furnaces with reference to the market for the iron is a consideration of no small importance, for the advantages of cheap material may be overbalanced by the difference of a few dollars in the cost of placing in market a product of so little value to the ton weight as pig iron.

The following statement gave the cost of the different items which went to make up the total expense of production at the localities named in 1859. The advance in the value of ores, cost of transportation, labor, and coal, have increased these items about 75 per cent. since 1863.

At different points on the Hudson river, anthracite furnaces are in operation, which are supplied with hematites from Columbia and Dutchess counties, N. Y., and from the neighboring counties in Massachusetts, at prices varying from $2.25 to $3.00 per ton; averaging about $2.50. They also use magnetic ores from Lake Champlain, and some from the Highlands below West Point, the latter costing $2.50, and the former $3.50 to $4.50 per ton; the average being about $3.50. The quantities of these ores purchased for the ton of iron produced are about two tons of hematite and one of magnetic ore, making the cost for the ores $6.75. Two tons of anthracite cost usually $9, and the flux for fuel about 35 cents. Actual contract prices for labor and superintendence have been $4 per ton. Thus the total expense for the ton of pig iron is about $20.10; or, allowing for repairs and interest on capital, full $21.

In the Lehigh valley, in Pennsylvania, are numerous furnaces, which are supplied with anthracite at the low rate of $3 per ton, or $6 to the ton of iron. The ores are mixed magnetic and hematites, averaging in the proportions used about $3 per ton, or, at the rate consumed of 2½ tons, $7.50 to the ton of iron. Allowing the same amount—$4.35—for other items, as at the Hudson river furnaces, the total cost is $17.85; or, with interest and repairs, nearly $19 per ton. The difference is in great part made up to the furnaces on the Hudson by their convenience to the great markets of New York, Troy, and Albany.

The charcoal iron made near Baltimore shows a higher cost of production than either of the above, and it is also subject to greater expenses of transportation to market, which is chiefly at the rolling mills and nail factories of Massachusetts. Its superior quality causes a demand for the product and sustains the business. For this iron per ton 2½ tons of ore are consumed, costing $3.62½ per ton, or $9.06; fuel, 3½ cords at $2.50, $8.75; flux, oyster shells, 30 cts.; labor (including $1.50 for charring) $2.75; other expenses, $2; total, $22.86.

At many localities in the interior of Pennsylvania and Ohio, iron is made at less cost, but their advantages are often counterbalanced by additional expenses incurred in delivering the metal, and obtaining the proceeds of its sale. Increased facilities of transportation, however, are rapidly removing these distinctions. At Danville, on the Susquehanna river, Columbia county, Pennsylvania, the cost of production has been reduced to an unusually low amount, by reason of large supplies of ore close at hand, the cheapness of anthracite, and the very large scale of the operations. Pig iron, as shown by the books of the company, has been made for $11 per ton. Its quality, however, was inferior, so that, with the expenses of transportation added, it could not be placed in the eastern markets to compete with other irons. Pig iron is produced more cheaply on the Ohio river and some of its tributaries than elsewhere, but there are no furnaces in the United States which can make a good article much less than $27 per ton.

### DISTRIBUTION OF THE ORES.

The magnetic and specular ores of the United States are found in the belt of metamorphic rocks—the gneiss, quartz rock, mica and talcose slates, and limestones—which ranges along to the east of the Alleghanies, and spreads over the principal part of the New England states. It is only, however, in certain districts, that this belt is productive in iron ores. The hematites belong to the same group, and the important districts of the three ores may be noticed in the order in which they are met from Canada to Alabama. Similar ores are also abundant in Missouri, and to the south of Lake Superior.

New England States.—In New Hampshire magnetic and specular ores are found in large quantities in a high granitic hill called the Baldface Mountain, in the town of Bartlett. The locality is not conveniently accessible, and its remoteness from coal mines will probably long keep the ore, rich and abundant as it is, of no practical value. At Piermont, on the western border of the state, specular ore, very rich and pure, is also abundant, but not worked. At Franconia a small furnace, erected in 1811, was run many years upon magnetic ores, obtained from a bed of moderate size, and which in 1824 had been worked to the depth of 200 feet. In 1830 the iron establishments of this place were still objects of considerable interest, though from the accounts of them published in the *American Journal of Science* of that year, it appears that the annual production of the blast furnace for the preceding nine years had averaged only about "216 tons of cast iron in hollow ware, stoves, machinery, and pig iron"—a less quantity than is now produced in a week by some of the anthracite furnaces. One forge making bar iron direct from the ore produced forty tons annually, and another 100 tons, consuming 550 bushels of charcoal to the ton. The cost of this, fortunately, was only from $3.75 to $4.00 per hundred bushels. A portion of the product was transported to Boston, the freight alone costing $25 per ton.

In Vermont these ores are found in the metamorphic slates of the Green Mountains, and are worked to some extent for mixing with the hematite ores, which are more abundant, being found in many of the towns through the central portion of the state, from Canada to Massachusetts. In 1850 the number of blast furnaces was ten, but their production probably did not reach 4,000 tons per annum, and has since dwindled away to a much less amount. At the same time there were seven furnaces in Berkshire, Mass., near the hematite beds that are found in the towns along the western line of the state. These had a working capacity of about 12,000 tons of pig iron annually, and this being made from excellent ores, with charcoal for fuel, its reputation was high and the prices remunerative; but as charcoal increased in price, and the cheaper anthracite-made iron improved in quality, the business became unprofitable; so that the extensive hematite beds are now chiefly valuable for furnishing ores to the furnaces upon the Hudson river, where anthracite is delivered from the boats that have come through the Delaware and Hudson canal, and magnetic ores are brought by similar cheap conveyance from the mines on the west side of Lake Champlain. Through Connecticut, down the Housatonic valley, very extensive beds of hematite have supplied the sixteen furnaces which were in operation ten years ago. The great Salisbury bed has already been named. In the first half of the present century it produced from 250,000 to 300,000 tons of the very best ore; the iron from which, when made with cold blast, readily brought from $6 to $10 per ton more than the ordinary kinds of pig iron. The Kent ore bed was of similar character, though not so extensive.

New York.—Across the New York state line, a number of other very extensive deposits of hematite supported seven blast furnaces in Columbia and Dutchess counties, and now furnish supplies to those along the Hudson river. In Putnam county, magnetic ores succeed the hematites, and are developed in considerable beds in Putnam Valley, east from Cold Spring, where they were worked for the supply of forges during the last century. These beds can again furnish large quantities of rich ore. On the other side of the river, very productive mines of magnetic ore have been worked near Fort Montgomery, six miles west from the river. At the Greenwood furnace, back from West Point, was produced the strongest cast iron ever tested, which, according to the report of the officers of the ordnance department, made to Congress in 1856, after being remelted several times to increase its density, exhibited a tenacity of 45,970 lbs. to the square inch. The beds at Monroe, near the New Jersey line, are of vast extent; but a small portion of the enormous quantities of ore in sight, however, makes the best iron. Mining was commenced here in 1750, and a furnace was built in 1751, but operations have never been carried on upon a scale commensurate with the abundance of the ores. In the northern counties of New York, near Lake Champlain, are numerous mines of rich magnetic ores. Some of the most extensive bloomary establishments in the United States are supported by them in Clinton county, and many smaller forges are scattered along the course of the Ausable river, where water power near some of the ore beds presents a favorable site. Bar iron is made at these establishments direct from the ores; and at Keeseville nail factories are in operation, converting a portion of the iron into nails. In Essex county there are also many very productive mines of the same kind of ore, and Port Henry and its vicinity has furnished large quantities, not only to the blast furnaces that were formerly in operation here, but to those on the Hudson, and to puddling furnaces in different parts of the country, particularly about Boston. In the interior of Essex county, forty miles back from the lake, are the extensive mines of the Adirondac. The ores are rich as well as inexhaustible, but the remoteness of the locality, and the difficulty attending the working of them, owing to their contamination with titanium, detract greatly from their importance. On the other side of the Adirondac mountains, in St. Lawrence county, near Lake Ontario, are found large beds of specular ores, which have been worked to some extent in several blast furnaces. They occur along the line of junction of the granite and the Potsdam sandstone. The iron they make is inferior—suitable only for castings. The only other ores of any importance in the state are the fossiliferous ores of the Clinton group, which are worked near Oneida Lake, and at several points along a narrow belt of country near the south shore of Lake Ontario. They have sustained five blast furnaces in this region, and are transported in large quantities by canal to the anthracite furnaces at Scranton, in Pennsylvania, the boats returning with mineral coal for the furnaces near Oneida Lake.

New Jersey.—From Orange county, in New York, the range of gneiss and hornblende rocks, which contain the magnetic and specular ores, passes into New Jersey, and spreads over a large part of Passaic and Morris, and the eastern parts of Sussex and Warren counties. The beds of magnetic ore are very large and numerous, and have been worked to great extent, especially about Ringwood, Dover, Rockaway, Boonton, and other towns, both in blast furnaces and in bloomaries. At Andover, in Sussex county, a great body of specular ores furnished for a number of years the chief supplies for the furnaces of the Trenton Iron Company, situated at Philipsburg, opposite the mouth of the Lehigh. On the range of this ore, a few miles to the north-east, are extensive deposits of Franklinite iron ore accompanying the zinc ore of this region. This unusual variety of ore consists of peroxide of iron about 66 per cent., oxide of zinc 17, and oxide of manganese 16. It is smelted at the works of the New Jersey Zinc Company at Newark, producing annually about 2,000 tons of pig iron. The metal is remarkable for its large crystalline faces and hardness, and is particularly adapted for the manufacture of steel, as well as for producing bar iron of great strength.

As the forests, which formerly supplied abundant fuel for the iron works of this region, disappeared before the increasing demands, attention was directed to the inexhaustible sources of anthracite up the Lehigh valley in Pennsylvania, with which this iron region was connected by the Morris canal and the Lehigh canal; and almost the first successful application of this fuel to the smelting of iron ores upon a large scale was made at Stanhope, by Mr. Edwin Post. A new era in the iron manufacture was thus introduced, and an immense increase in the production soon followed, as the charcoal furnaces gave place to larger ones constructed for anthracite. The Lehigh valley, lying on the range of the iron ores toward the southwest, also produced large quantities of ore, which, however, was almost exclusively hematite. Hence, an interchange of ores has been largely carried on for furnishing the best mixtures to the furnaces of the two portions of this iron district; and the operations of the two must necessarily be considered together. The annual production, including that of the bloomaries of New Jersey, has reached, within a few years, about 244,000 tons of iron. But in a prosperous condition of the iron business this can be largely increased without greatly adding to the works already established, while the capacity of the iron mines and supplies of fuel are unlimited. The proximity of this district to the great cities, New York and Philadelphia, adds greatly to its importance.

PENNSYLVANIA.—Although about one-half of all the iron manufactured in the United States is the product of the mines of Pennsylvania, and of the ores carried into the state, the comparative importance of her mines has been greatly overrated, and their large development is rather owing to the abundant supplies of mineral coal conveniently at hand for working the ores, and, as remarked by Mr. Lesley ("Iron Manufacturer's Guide," p. 433), "to the energetic, persevering German use for a century of years of what ores do exist, than to any extraordinary wealth of iron of which she can boast. Her reputation for iron is certainly not derived from any actual pre-eminence of mineral over her sister states. New York, New Jersey, Virginia, and North Carolina, are far more liberally endowed by nature in this respect than she. The immense magnetic deposits of New York and New Jersey almost disappear just after entering her limits. The brown hematite beds of her great valley will not seem extraordinary to one who has become familiar with those of New York, Massachusetts, Vermont, Virginia, and Tennessee. Her fossil ores are lean and uncertain compared with those of the south; and the carbonate and hematized carbonate outcrops in and under her coal measures will hardly bear comparison with those of the grander outspread of the same formations in Ohio, Kentucky, and western Virginia." The principal sources of iron in the state are, first, the hematites of Lehigh and Berks counties—the range continuing productive through Lancaster, also on the other side of the intervening district of the new red sandstone formation. The ores are found in large beds in the limestone valley, between the South and the Kittatinny mountains; those nearest the Lehigh supply the furnaces on that river, already amounting to twenty-three in operation and four more in course of construction, and those nearer the Schuylkill supply the furnaces along this river. The largest bed is the Moselem, in Berks county, six miles west-south-west from Kutztown. It has been very extensively worked, partly in open excavation and partly by underground mining, the workings reaching to the depth of 165 feet. Over 250,000 tons a year of ore have been produced at a cost of from $1.30 to $1.50 per ton.

Magnetic ores are found upon the Lehigh, or South Mountain, the margin on the south of the fertile limestone valley which contains the hematite beds. These, however, though large, are insufficient, the dependence of the great iron furnaces of the Lehigh for these ores being in part on the extensive mines of New Jersey; while the only supplies of magnetic ores to the furnaces of the Schuylkill and the Susquehanna are from the great Cornwall mines, four miles south of Lebanon. An immense body of magnetic iron ore, associated with copper ores, has been worked for a long time at this place, at the junction of the lower silurian limestones and the red sandstone formation. The bed lies between dikes of trap, and exhibits peculiarities that distinguish it from the other bodies of iron ore on this range. The Warwick, or Jones' mine, in the south corner of Berks county, resembles it in some particulars. Its geological position is in the upper slaty layers of the Potsdam sandstone, near the meeting of this formation with the new red sandstone. Trap dikes penetrate the ore and the slates, and the best ore is found at both mines near the trap. Not far from York, Pa , an ore known as the Codorus Iron Ore has been raised for some years, but was regarded as almost worthless, but recent experiments have led to the discovery that it contains the exact ingredients necessary to make it the best of fluxes for reducing the other ores of that region to steel of excellent quality without any intermediate process. Along the Maryland line, on both sides of the

Susquehanna, chrome iron has been found in considerable abundance in the serpentine rocks, and has been largely and very profitably mined for home consumption and for exportation. It furnishes the different chrome pigments, and their preparation has been carried on chiefly at Baltimore.

A portion of the hematites which supply the furnaces on the Schuylkill, occur along a narrow limestone belt of about a mile in width, that crosses the Schuylkill at Spring Mill, and extends north-east into Montgomery county, and south-west into Chester county. Their production has been very large, and that of the furnaces of the Schuylkill valley dependent upon these and the other mines of this region has been rated at 100,000 tons of iron annually.

The great Chestnut hill hematite ore bed, three and a half miles north-east of Columbia, Lancaster county, covers about twelve acres of surface, and has been worked in numerous great open excavations to about 100 feet in depth, the ore prevailing throughout among the clays and sands from top to bottom. "The floor of the mine is hard, white Potsdam sandstone, or the gray slaty layers over it. The walls show horizontal wavy layers of blue, yellow, and white laminated, unctuous clays, from forty to sixty feet deep, containing ore, and under these an irregular layer of hard concretionary, cellular, fibrous, brown hematite from ten to thirty feet thick down to the sandstone." ("Iron Manufacturer's Guide, p. 562.") In the accompanying wood-cut, the darkly shaded portions represent the hematites, while the lighter portions above are chiefly clays. Professor Rogers supposes that the ore has leached down from the upper slaty beds through which it was originally diffused, and has collected upon the impervious sandstone, which in this vicinity is the first water bearing stratum for the wells.

CHESTNUT HILL MINE.

The repeated occurrence of the lower silurian limestones and sandstones along the valleys of central Pennsylvania, from the Susquehanna to the base of the Alleghany mountain, is accompanied through these valleys with numerous beds of hematite; and to the supplies of ore they have furnished for great numbers of furnaces, is added the fossiliferous ore of the Clinton group, the outcrop of which is along the slopes of the ridges and around their ends. Many furnaces have depended upon this source of supply alone. As stated by Lesley, there were, in 1857, 14 anthracite furnaces that used no other, and 11 anthracite furnaces which mixed it either with magnetic ore or hematite, or with both. Montour's ridge, at Danville, Columbia county, referred to on page 24, is one of the most remarkable localities of this ore. Professor Rogers estimated, in 1847, that there were 20 furnaces then dependent upon the mines of this place, and producing annually an average of 3,000 tons of iron each, with a consumption of 9,000 tons of ore, or a total annual consumption of 180,000 tons. At this rate, he calculated that the available ore would be exhausted in 20 years.

Between the Clinton group and the coal measures are successive formations of limestones, sandstones, shales, etc., which form a portion of the geological column of many thousand feet in thickness; and among these strata, ores like the carbonates of the coal measures are occasionally developed, and these are recognized and worked at many localities along the outcrop of the formations to which they belong. Along the summit of the Alleghany mountain the base of the coal measures is reached, which thence spread over the western portion of the state, nearly to its northern line. The ores which belong to this formation are chiefly contained among its lower members, and found in the outcrop of these around the margin of the basin. At some localities they have been obtained in considerable abundance, and many furnaces have run upon them alone, but they are an uncertain dependence. The four counties, Lehigh, Lebanon, Berks, and Blair raised, in 1880, 1,014,805 tons of iron ore, and Fayette, York, and Lancaster, 190,636 tons more, making an aggregate for seven counties of 1,205,441 tons, or more than one-seventh of the whole product of the year in the United States.

MARYLAND.—The metamorphic belt crosses this state back of Baltimore, and is productive in chromic iron and copper ores, rather than in magnetic and specular ores. Some of the former, highly titaniferous, have been worked near the northern line of the state, on the west side of the Susquehanna; and at Sykesville, on the Potomac, a furnace has been supplied with specular ores from its vicinity. Several hematite beds within twenty miles of Baltimore have supplied considerable quantities of ore for mixture with the tertiary carbonates, upon which the iron production of the state chiefly depends. Beds of these occur near the bay from Havre de Grace to the District of Columbia. In the western part of the state large furnaces were built at Mount Savage and Lonacoming to work the ores of the coal formation; but the supply has proved insufficient to sustain them. In 1880, the blast furnaces and bloomaries of the state produced nearly 111,000 tons of iron.

SOUTHERN STATES.—South of Maryland the same iron belt continues through Virginia, the Carolinas, and Georgia; and although it is often as productive in immense beds of the three varieties of ore — the magnetic, specular, and hematite—as in the other states along its range, these resources add comparatively little to the material wealth of the states to which they belong. Through Virginia, east and west of the Blue Ridge, hematite ores abound in the limestone valleys, and magnetic ores are often in convenient proximity to them. Many small furnaces have worked them at different times, but their product was always small. Three belts of magnetic ore, associated with specular iron and hematites, are traced across the midland counties of North Carolina, and have furnished supplies for furnaces and forges in a number of counties—as Lincoln, Cleveland, Rutherford, Stokes, Surry, Yadkin, Catawba; and Chatham, Wake, and Orange counties upon the eastern belt. The belt of ore from Lincoln county passes into South Carolina, and through York, Union, and Spartanburg districts. It crosses the Broad river at the Cherokee ford, and though the whole belt is only half a mile wide, it presents numerous localities of the three kinds of ore, and of limestone also in close proximity, and finely situated for working. Several other localities are noticed in the "State Geological Report," by M. Tuomey, who remarks, on page 278, that "if iron is not manufactured in the state as successfully as elsewhere, it is certainly not due to any deficiency in natural advantages." In northern Georgia the ferruginous belt is productive in immense bodies of hematite, associated with magnetic and specular ores, in the Allatoona hills, near the Etowah river, in Cherokee and Cass counties. This, which appears to be one of the great iron districts of the United States, is bountifully provided with all the materials required in the manufacture, and traversed by a railroad which connects it with the bituminous coal mines of eastern Tennessee. In Alabama, hematites and specular ores accompany the belt of silurian rocks to its southern termination, and are worked in a few bloomary fires and two or three blast furnaces. The fossiliferous ore of the Clinton group is also worked in this state. The production of the furnaces and bloomaries of Virginia, West Virginia, North Carolina, and Georgia and Alabama in iron and steel, in 1880, amounts to 302,000 tons, or more than $11,000,000.

TENNESSEE in 1840 ranked as the third iron-producing state in the Union. The counties ranging along her eastern border produced hematite ores, continuing the range of the silurian belt of the great valley of Virginia; those bordering the Clinch river produced the fossil ore of the Clinton group, there known as the dyestone ore; and western Tennessee presented a very interesting and important district of hematites belonging to the subcarboniferous limestone in the region lying east of the Tennessee and south of the Cumberland river.* The furnaces of this district, which have numbered forty-two in all, were the greater part of them in Dickson, Montgomery, and Stewart counties. They were all supplied with charcoal for fuel, at a cost of $4 per hundred bushels. In 1854 the product of pig iron was 37,918 tons; but it gradually declined to 27,050 tons in 1857; and in August, 1858, only fifteen furnaces were in operation. It was confidently expected that after the close of the war, with her excellent ores and her extensive forests and coal beds, she would again lead the southwestern states in the production of both charcoal and coke iron, but for some reason she has failed to do so, and in 1880 stood tenth in the list of iron-producing states, making but 104,465 tons of iron and steel.

Kentucky.—The western part of this state contains, in the counties of Calloway, Trigg, Lyon, Caldwell, Livingston, and Crittenden, an important district of hematite ores—the continuation northward of that of Tennesse. In 1857 ten charcoal furnaces produced 15,600 tons of iron. Eastern Kentucky, however, has a much more productive district in the counties of Carter and Greenup, which is an extension south of the Ohio of the Hanging Rock iron district of Ohio. The ores are carbonates and hematite outcrops of carbonates, belonging to the coal measures and the subcarboniferous limestone. They are in great abundance; a section of 740 feet of strata terminating below with the limestone named, presenting no less than fourteen distinct beds of ore, from three inches to four feet each, and yielding from 25 to 60 per cent. of iron. One bed of 32 per cent. iron contains also 11 per cent. bitumen—a composition like that of the Scotch "black band" ore. Others contain so much lime that the ores are valuable for fluxing as well as for producing iron. The furnaces use charcoal and coke. Their production places this region among the first in importance in the United States, yet Kentucky, in 1880, produced but 64,809 tons of iron.

Ohio.—The ores of this state, like those of Kentucky, belong almost exclusively to the coal measures and the limestone formations beneath. In both states some of the fossiliferous ore also is found, but is comparatively unimportant. The productive beds are near the base of the coal formation, ranging from the Hanging Rock district of Scioto and Lawrence counties northeast, through Jackson, Hocking, Athens, Perry, Muskingum, Tuscarawas, Mahoning, and Trumbull counties, to the line of Mercer county in Pennsylvania. The uncertain character of the ores, both as to supply and quality, is strikingly shown by the fact that many of the furnaces of the more northern counties depend for a considerable portion—one-fourth or more—of the ores they use upon the rich varieties from Lake Superior and Lake Champlain. Although the long transportation makes these ores cost nearly three times as much per ton as those of the coal formation, some furnaces find it more profitable to use the former, even in the proportion of three-fourths, on account of the much better iron produced, the greater number of tons per day, and the less consumption of fuel to the ton. The fuel employed was formerly charcoal in most of the furnaces, but bituminous coal is now generally used. Ohio produced in 1880, 930,141 tons of iron and steel.

Indiana and Illinois contain no important bodies of iron ore. The coal measures, which cover large portions of these states, are productive in some small quantities of the carbonates, but the block coal of Indiana, and the somewhat similar coal of Illinois, are so excellent for smelting purposes that iron ores are brought from Missouri and Lake Superior to be smelted there. Indiana produced in 1880, 96,117 tons, and Illinois 417,967 tons of iron and steel.

Michigan.—The iron region of this state is in the upper peninsula, between Green Bay and Lake Superior. Magnetic and specular ores are found throughout a large portion of this wild territory, in beds more extensive than are seen in any other part

* "It is remarkable that most of these deposits are of what is called pot ore, that is, hollow balls of ore, which, when broken open, look like broken caldrons. One of them, preserved by Mr. Lewis, is eight feet across the rim! Another is six feet across. The majority are crossed within by purple diaphragms or partitions of ore, and the interstitial spaces are filled with yellow ochre. Some, like the great eight-foot pot, are found to be full of water. The inside surface is mammillary, irregular, sometimes botryoidal or knobby, but the outside is pretty smooth and regular. All these pots were undoubtedly once balls of carbonates of lime and iron segregated in the original deposit."

of the United States—perhaps than are anywhere known. The district approaches within twelve miles of the coast of Lake Superior, from which it is more conveniently reached than from the south side of the peninsula. The ores are found in a belt of crystalline slates, of six to ten miles in width, that extends west from the lake shore, and is bounded north and south by a granitic district. They are developed in connection with great dikes and ridges of trap, which range east and west, and dip with the slates at a high angle towards the north. The ores also have the same direction and dip. Localities of them are of frequent occurrence for eighteen miles in a westerly direction from the point of their nearest approach to Lake Superior. A second range of the beds is found along the southern margin of the slate district; and about thirty miles back from the lake, where the slates extend south into Wisconsin, similar developments of ore accompany them to the Menomonee river and toward Green Bay. The quality of the ore found at different places varies according to the amount of quartz, jasper, hornblende, or feldspar that may be mixed with it: but enormous bodies are nearly pure ore, yielding from 68 to 70 per cent. of iron, and free from a trace even of manganese, sulphur, phosphorus, or titanium. A single ridge, traced for about six miles, rising to a maximum height of fifty feet above its base, and spreading out to a width of one thousand feet, has been found to consist of great longitudinal bands of ore, much of which is of this perfectly pure character. Another ridge presents precipitous walls fifty feet high, composed in part of pure specular ore, fine grained, of imperfect slaty structure, and interspersed with minute crystals of magnetic oxide; and in part of these minute crystals alone. Another body of one thousand feet in width, and more than a mile long, forms a hill one hundred and eighty feet high, which is made up of alternate bands of pure, fine-grained steel-gray peroxide of iron, and deep red jaspery ore—the layers generally less than a fourth of an inch in thickness, and curiously contorted. Their appearance is very beautiful in the almost vertical walls. On one of the head branches of the Escanaba is a cascade of thirty-seven feet in height, the ledge over which the water falls being a bed of peroxide of iron, intermixed with silicious matter. For the supply of the few furnaces and bloomary establishments already in operation in this district, and for the larger demands of distant localities, the ores are collected from open quarries, and from the loose masses lying around. A railroad affords the means of transporting them to Marquette, on the lake shore, whence they are shipped by vessels down the lake. The business already amounts to more than 100,000 tons per annum, and is increasing very rapidly. With the Bay de Noquet and Marquette railroad completed there now is a southern terminus of this road on Green Bay, and an outlet being opened in this direction, the production of iron ores will no doubt eventually exceed that of any other region in the country. Large quantities will be reduced with charcoal in blast furnaces and bloomaries in the region itself. Michigan produced in 1880, 1,834,712 tons of iron ore, the greater part of which was exported, but she made also 142,716 tons of iron and steel.



Wisconsin.—Magnetic and specular ore in bodies, somewhat resembling those of the region just described, are found in the extreme northern part of Wisconsin, upon what is known as the Penokie range, distant about twenty-five miles from Chegwomigon Bay, Lake Superior. Bad river and Montreal river drain this district. The ores, though remote, are likely to be of considerable practical importance. Other immense bodies of these ores, estimated to contain many millions of tons, are found on Black river, which empties into the Mississippi below St. Croix river, on the line of the Land Grant Branch railroad. Furnaces have been built to work these mines. In the eastern part of Wisconsin the oolitic ore of the Clinton group is met with in Dodge and Washington counties, and again at Depere, seven miles southeast of Green Bay. In the town of Hubbard, Dodge county, forty miles west from Lake Michigan, is the largest deposit of this ore ever discovered. It spreads in a layer ten feet thick over 500 acres, and is estimated to contain 27,000,000 tons. It is in grains, like sand, of glistening red color, staining the hands. Each grain has a minute nucleus of silex, around which the oxide of iron collected. The percentage of metal is about fifty. Wisconsin, in 1880, raised 41,440 tons of iron ore, but she made, probably from Lake Superior ores in part, 178,935 tons of iron and steel.

Missouri.—This state must be classed among the first in the abundance of its iron ores, though up to this time comparatively little has been done in the development of its mines. The ores are hematites, magnetic, and specular, and all occur in the isolated district of silurian rocks—formations which almost everywhere else in the western middle states are concealed beneath the more recent formations. This region yields more than two-thirds of the ore, and almost the whole of the iron and steel produced in the state. In the counties along the St. Louis, Iron Mountain, and Great Northern railway, Prof. Swallow, the state geologist, reports no less than ninety localities of hematite. These are in Iron, St. François, Jefferson, Franklin, Crawford, Phelps, Pulaski, Marion, Greene and other counties. The first attempts to smelt iron in Missouri, and probably in any state west of Ohio, were made in Washington county in 1823 or 1824, and with the hematites of the locality were mixed magnetic ores from the Iron mountain. In Franklin county there is but one furnace, though on both sides of the Maramec are beds of hematite pipe ore, which cover hundreds of acres. The Iron mountain district is about sixty miles back from the Mississippi river (the nearest point on which is St. Genevieve), and extends from the Iron mountain, in Iron county, to the southwestern part of St. François county. It includes three important localities of specular ore: the Iron mountain, Pilot Knob, and Shepherd mountain. The first is a hill of gentle slopes, 228 feet high above its base, and covering about 500 acres—a spur of the porphyritic and syenitic range on the east side of Bellevue valley. In its original state, as seen by the writer in 1841, it presented no appearance of rock in place, its surface was covered with a forest of oak, the trees thriving in a soil wholly composed of fragments of peroxide of iron, comminuted and coarse mixed together. Loose lumps of the ore were scattered around on every side but the north, and upon the top were loose blocks of many tons weight each. Mining operations, commenced in 1845, developed only loose ore closely packed with a little red clay. An Artesian well was afterwards sunk to the depth of 152 feet. It passed through the following strata in succession: iron ore and clay, 16 feet; sandstone, 34 feet; magnesian limestone, 7½ inches; gray sandstone, 7½ inches; "hard blue rock," 37 feet; "pure iron ore," 5 feet; porphyritic rock, 7 feet; iron ore 50 feet to the bottom. The ore appears to be interstratified with the silicious rocks with which it is associated in a similar manner to its occurrence at the other localities. In quality the ore is a very pure peroxide; it melts easily in the furnace, making a strong forge pig, well adapted for bar iron and steel. Two charcoal furnaces have been in operation for a number of years, and up to the close of 1880 had produced a million tons of iron. The flux is obtained from the magnesian limestone, which spreads over the adjoining valley in horizontal strata.

Pilot Knob is a conical hill of 580 feet height above its base, situated six miles south of the Iron mountain. Its sides are steep, and present bold ledges of hard, slaty, silicious rock, which lie inclined at an angle 20° to 30° toward the southwest.

Near the top the strata are more or less charged with the red peroxide of iron, and loose blocks of great size are seen scattered around, some of them pure ore, and some ore and rock mixed. At the height of 440 feet above the base, where the horizontal section of the mountain is equal to an area of fifty-three acres, a bed of ore is exposed to view on the north side, which extends 273 feet along its line of outcrop, and is from nineteen to twenty-four feet in thickness. Other similar beds are said to occur lower down the hill; and higher up others are met with to the very summit. The peak of the mountain is a craggy knob of gray rocks of ore, rising sixty feet in height, and forming so conspicuous an object as to have suggested the name by which the hill is called. The ore is generally of more slaty structure than that of the Iron mountain. The quantity of very pure ore conveniently at hand is inexhaustible. The production of iron will be limited more for want of abundance of fuel than of ore. Charcoal, though now obtained in abundance, may fail or become too high, and bituminous coal is already brought from the coal mines of Missouri and Illinois, while the ores are also carried to the river to meet there the fuel. Both localities are already connected with St. Louis by a railroad.

Shepherd mountain, about a mile distant from the Pilot Knob towards the southwest, is composed of porphyritic rocks, which are penetrated with veins or dikes of both magnetic and specular ores. These run in various directions, and the ores they afford are of great purity. They are mined to work together with those of the Pilot Knob. The mountain covers about 800 acres, and rises to the height of 660 feet above its base. Other localities of these ores are also known, and the occurrence of specular ore is reported by the state geologists in several other counties, as Phelps, Crawford, Pulaski, La Clede, etc. There are now 22 blast furnaces, bloomaries, etc., in Missouri, and they produced, in 1880, 115,558 tons of pig and rolled iron, and 10,200 tons of steel. The state produced the same year 386,197 tons of iron in ore.

In many parts of the United States and its territories iron is known to exist in great quantities. In Nebraska and Wyoming territory, near the line of the Union Pacific Railroad, large beds of iron ore of good quality are found, in proximity to extensive coal deposits, and these will be utilized for making rails of iron or steel for that great thoroughfare. In Kansas, Colorado, and New Mexico, are beds of specular and other ores in great profusion. Ores are mined and iron is made in Oregon, California, Utah, Wyoming, and Nebraska, not yet in large quantities but increasing with each year, and the iron is of the very best quality. West Virginia now ranks 14th in the amount of ore, and 7th in the quantity of iron and steel produced.

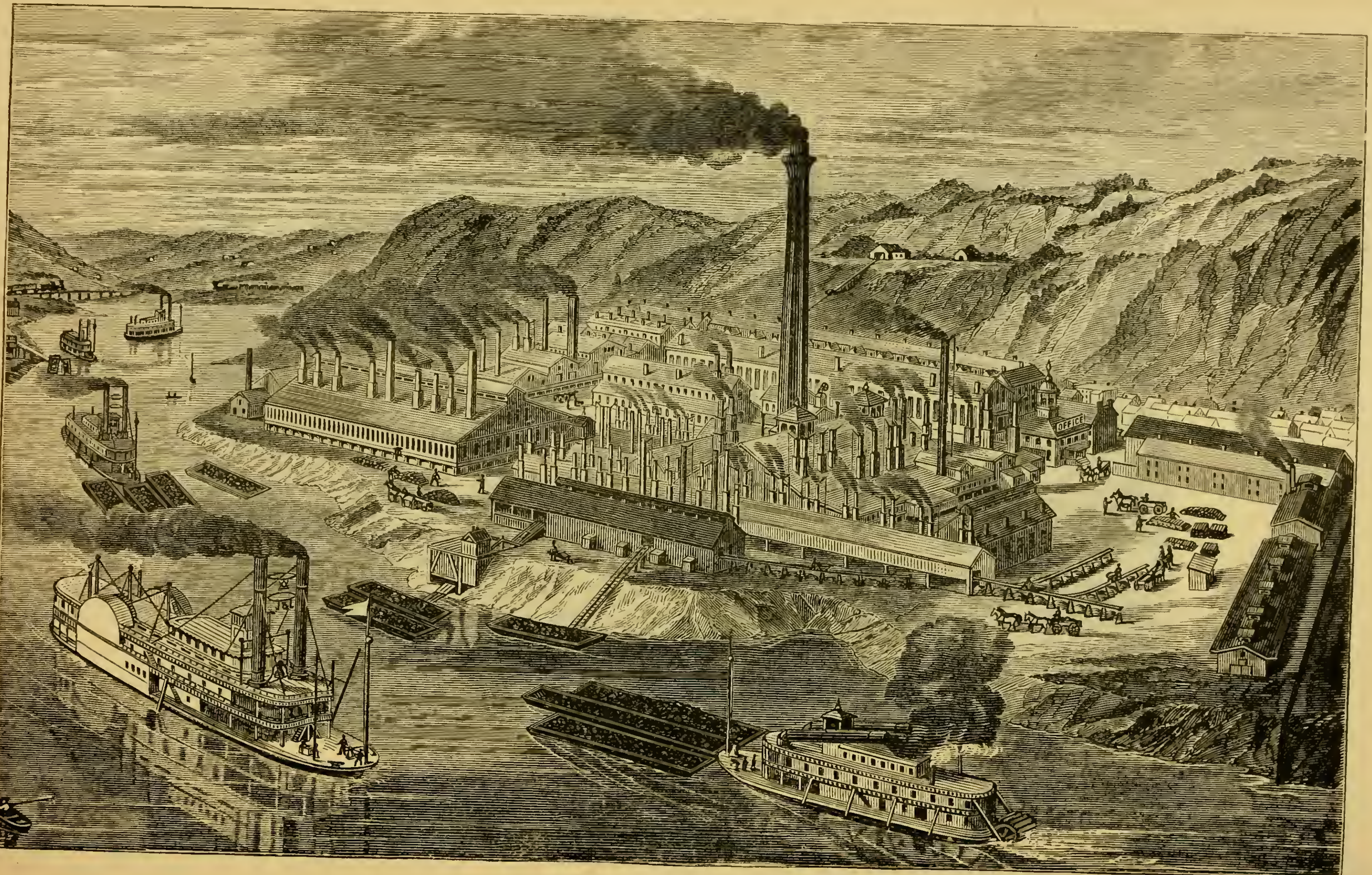
### IRON MANUFACTURE.

Iron is known in the arts chiefly in three forms—cast iron, steel, and wrought iron. The first is a combination of metallic iron, with from 1½ to 5 or 5½ per cent. of carbon; the second is metallic iron combined with ½ to 1½ per cent. of carbon; and the third is metallic iron, free as may be from foreign substances. These differences of composition are accompanied with remarkable differences in the qualities of the metal, by which its usefulness is greatly multiplied. The three sorts are producible as desired directly from the ores, and they are also convertible one into the other; so that the methods of manufacture are numerous, and new processes are continually introduced. The production of wrought iron direct from the rich natural oxides, was until modern times the only method of obtaining the metal. Cast iron was unknown until the 15th century. Rude nations early learned the simple method of separating the oxygen from the ores by heating them in the midst of burning charcoal; the effect of which is to cause the oxygen to unite with the carbon in the form of carbonic acid or carbonic oxide gas, and escape, leaving the iron free, and in a condition to be hammered at once into bars. The heat they could command in their small fires was insufficient to effect the combination of the iron, too, with the carbon, and produce the fusible compound known as cast iron. In modern times the great branch of the business is the production of pig metal or cast iron in blast furnaces; and this is afterward remelted and cast in moulds into the forms required, or it is converted into wrought iron to serve some of the innumerable uses of this kind of iron, or to be changed again into steel. In this order the principal branches of the manufacture will be noticed.

The production of pig metal in blast furnaces is the most economical mode of separating iron from its ores, especially if these are not extremely rich. The process requiring little labor, except in charging the furnaces, and this being done in great part by labor-saving machines, it can be carried on upon an immense scale with the employment of few persons, and most of those ordinary laborers. The business, moreover, has been greatly simplified and its scale enlarged by the substitution of mineral coal for charcoal—the latter fuel, indeed, could never have been supplied to meet the modern demands of the manufacture.

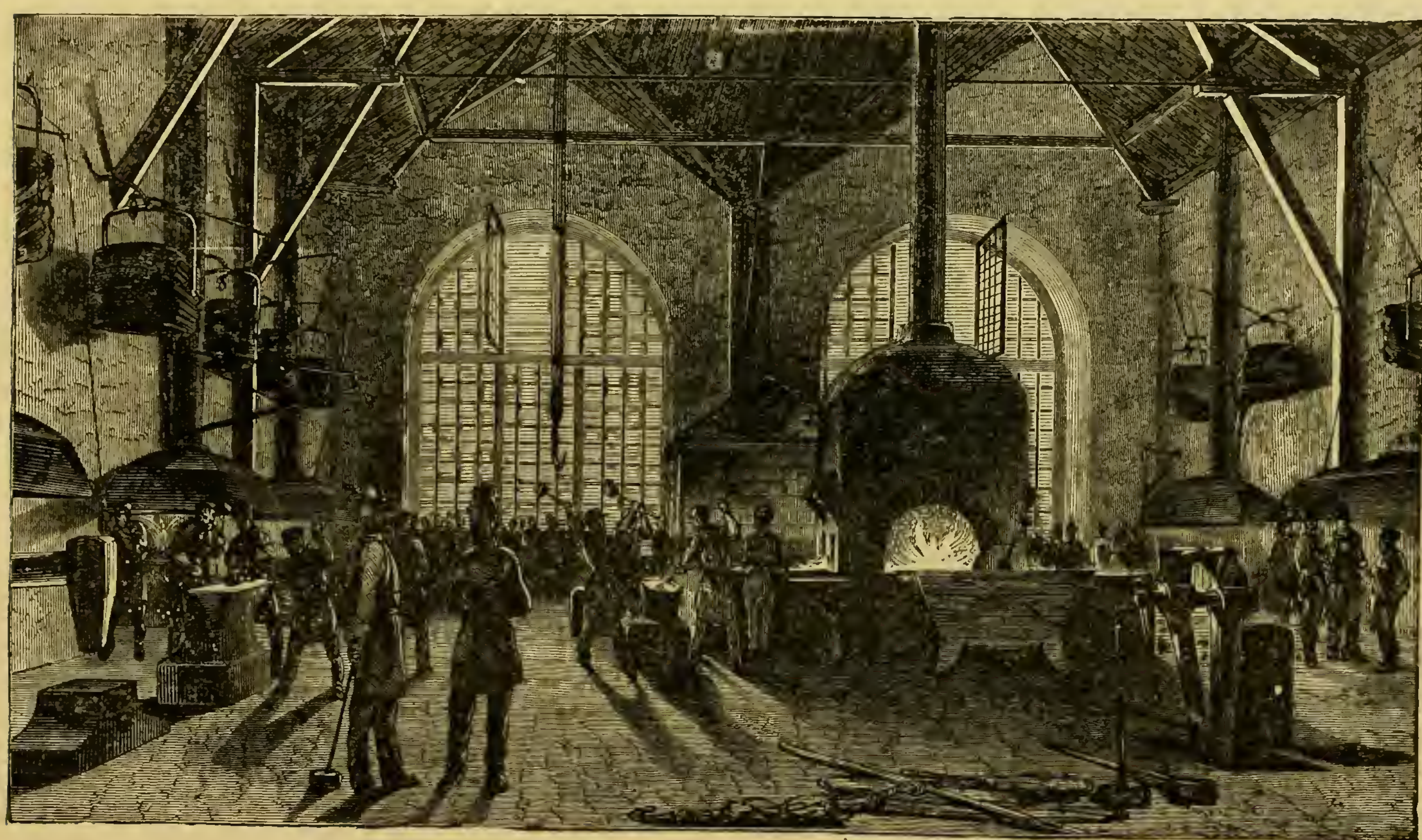
Blast furnaces are heavy structures of stone work, usually in pyramidal form, built upon a base of 30 to 45 feet square, and from 30 to 60 feet in height. The outer walls, constructed with immense solidity and firmly bound together, inclose a central cavity, which extends from top to bottom and is lined with large fire brick of the most refractory character, and specially adapted in their shapes to the required contour of the interior. The form of this cavity is circular in its horizontal section, and from the top goes on enlarging to the lower portion, where it begins to draw in by the walls changing their slope toward the centre. This forms what are called the boshes of the furnace—the part which supports the great weight of the ores and fuel that fill the interior. For ores that melt easily and fast they are made steeper than for those which are slowly reduced. The boshes open below into the hearth—the central contracted space which the French name the crucible of the furnace. The walls of this are constructed of the most refractory stones of large size, carefully selected for their power to resist the action of fire, and seasoned by exposure for a year or more after being taken from the quarry. Being the first portion to give out, the stack is built so that they can be replaced when necessary. The hearth is reached on each side of the stack by an arch, extending in from the outside. On three sides the blast is introduced by iron pipes that pass through the hearth-stones, and terminate in a hollow tuyere, which is kept from melting by a current of wa er brought by a lead or block-tin pipe, and made to flow continually through and around its hollow shell. The fourth side is the front or working-arch of the furnace, at the bottom of which access is had to the melted materials as they collect in the receptacle provided for them at the base of the hearth or crucible. This arch opens out into the casting-house, upon the floor of which are the beds in the sand for moulding the pigs into which the iron is to be cast. Upon the top of the stack around the central cavity are constructed, in first-class furnaces, large flues, which open into this cavity for the purpose of taking off a portion of the heated gaseous mixtures, that they may be conveyed under the boilers, to be there more effectually consumed, and furnish the heat for raising steam for the engines. A portion of the gases is also led into a large heating-oven, usually built on the top of the stack, in which the blast (distributed through a series of cast iron pipes) is heated by the combustion. These pipes are then concentrated into one main, which passes down the stack and delivers the heated air to the tuyeres, thus returning to the furnace a large portion of the heat which would otherwise escape at the top, and adding powerfully to the efficiency of the blast by its high temperature. The boilers, also conveniently arranged on the top of the furnace, especially when two furnaces are constructed near together, are heated by the escape gases without extra expense of fuel, and they furnish steam to the engines, which are usually placed below them. On account of the enormous volume of air, and the great pressure at which it is blown into the furnace, the engines are of the most powerful kind, and the blowing cylinders are of great dimensions and strength. Some of the large anthracite furnaces employ cylinders 7½ feet diameter, and 9 feet stroke. One of these running at the rate of 9 revolutions per minute, and its piston acting in both directions, should propel every minute 7,128 cubic feet of air (less the loss by leakage) into the furnace—a much greater weight than that of all the other materials introduced. It is, moreover, driven in at a pressure (produced by the contracted aperture of the nozzle of the tuyeres in relation to the great volume of air) of 7 or 8 lbs. upon the square inch. Two such cylinders answer for a pair of the largest furnaces, and should be driven by separate engines, so that in case of accident the available power may be extended to either or both furnaces. It is apparent that the engines, too, should be of the largest class and most perfect construction; for the blast is designed to be continued with only temporary interruptions that rarely exceed an hour at a time, so long as the hearth may remain in running order—a period, it may be, of 18 months, or even 4 or 5 years. Furnaces were formerly built against a high bank, upon the top of which the stock of ore and coal was accumulated, and thence carried across a bridge, to be delivered into the tunnel-head or mouth of the furnace. The more common arrangement at present is to construct, a little to one side, an elevator, provided with two platforms of sufficient size to receive several barrows. The moving power is the weight of a body of water let into a reservoir under the platform when it is at the top. This being allowed to descend with the empty barrows, draws up the other platform with its load, and the water is discharged by a self-regulating valve at the bottom. The supply of water is furnished to a tank in the top either by pumps connected with the steam engine or by the head of its source.

The furnaces of the United States, though not congregated together in such large numbers as at some of the great establishments in England and Scotland, are unsurpassed in the perfection of their construction, apparatus, and capacity; and none of large size are probably worked in any part of Europe with such economy of materials. The Siemen's regenerating furnace is adopted in those more recently built, wherever an intense heat is required for the reduction of the ores.

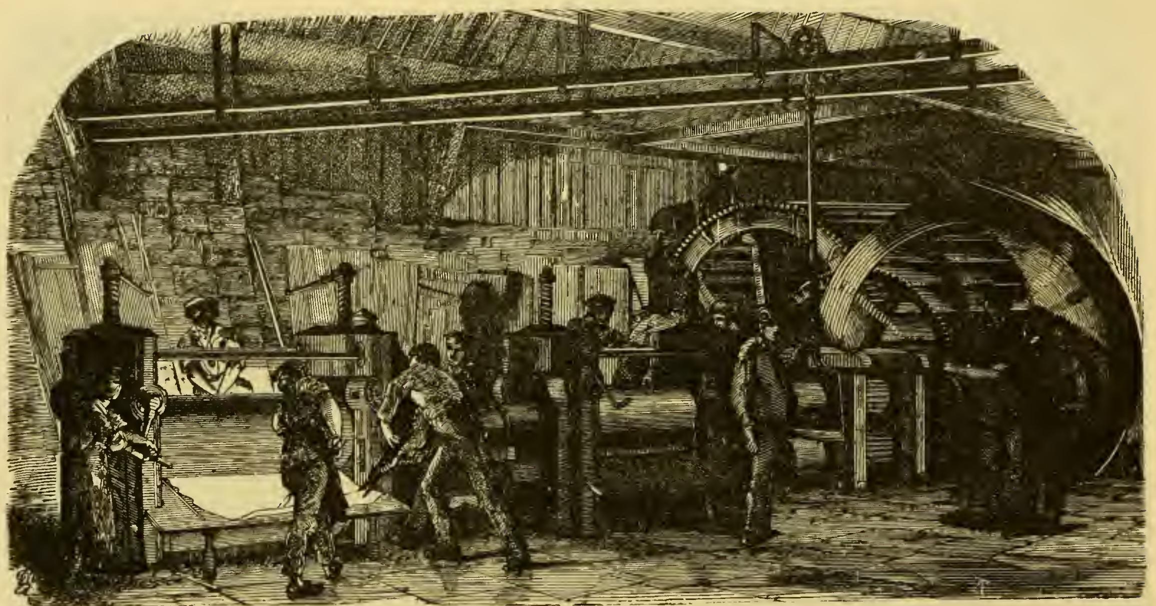



AMERICAN IRON WORKS, PITTSBURG, PA.

SMELTING PIG IRON.



FORGES AT CHALONS.



FLATTENING MACHINE.

## WROUGHT IRON.

It has been, in the past, a just ground of complaint against the producers of wrought iron and steel, that they could not reduce either directly from the ore—but must go through the long and tedious processes of first making pig or cast iron, then eliminating the carbon from the cast iron by a still more tedious process to produce the wrought iron, and then restore a part of the carbon to make steel. It was said with truth that the half civilized Hindoo tribes and even the barbarous Fans of West Africa, made their native wrought iron (the *wootz* of India) directly from the ore of an excellent quality, and by a much simpler process than was adopted either in Europe or the United States.

There has been, until within the past fifteen or eighteen years, a spirit strongly adverse to progress or improvement among iron producers. By their rude and wasteful processes and their adherence to traditional methods and tests, they succeeded in making a fair though not very uniform quality of wrought iron, at a pretty high cost, but they deprecated any change even if it were for the better. The philosophy and chemistry of iron-making were not well understood, and the time and way of its "coming to nature" a term which conveys the idea of a mystery, was a secret which could only be learned, it was thought, by some supernatural inspiration or some extraordinary skill, only to be acquired by long experience and careful observation.

The Bessemer process, invented and put in practice about 1852, first disturbed this popular idea; but in its earlier history this process was not entirely free from guess-work and the coming-to-nature theory by some sudden and unexplicable change; subsequent discoveries and experiments removed this mystery entirely, and there is not, to-day, in practical chemistry and metallurgy a more thoroughly-defined science than that of making iron The iron master, who is fully educated for his business, having before him an accurate analysis of his ores, and knowing, as he can if he will, that they are constant in their composition, proceeds with the utmost certainty to add other ores, or to permeate the molten ore with atmospheric air, or to force additional oxygen through it by means of nitrate of soda, nitrate of potassa, peroxide of iron, or other oxygen-yielding compound, or introduces a definite quantity of manganese, powdered charcoal, or spiegeleisen, or in some cases silica, to act as flux and remove the sulphur, phosphorus, or other impurity, and to destroy the excess of carbon. He knows, too, just what heat is requisite, and how long it must be continued to produce a certain result every time. Here is no guess-work, no "rule of thumb," no uncertainty. If he requires the best steel for rails, he can furnish it of precisely standard quality every time; if he is producing steel for the finest cutlery he can produce that; if he desires a wrought iron which shall be so tough and flexible that it can be bent double cold without any symptoms of flaw or crack, he knows just what percentage of the different ores, what eliminating processes, and what amount and duration of heat is necessary to produce it.

Now, as in the past, there are different grades and qualities of cast iron, wrought iron, and steel, intended for different purposes, made from different ores, and possessing different degrees of tenacity, hardness, and ductility; but the iron-maker who cannot produce from a given ore, or ores, that description of iron which he desires, without failure, does not understand his business.

Cast iron contains, according to the purpose for which it is intended, from five to six and a half per cent of pure carbon, either chemically or mechanically combined, and except the combination of iron with hydrogen, which is its normal condition, it is not the better for any admixture of other metals or elements, though for some purposes a small percentage of manganese, tungsten, or even a little silicon, are not disadvantageous. As a matter of practical fact, however, both sulphur and phosphorus are usually present, though in good samples in very small amount. By sufficient care they can be almost entirely eliminated, and are so in the best steel and wrought iron.

Steel, according to the purpose to which it is to be applied, contains, in chemical combination it is believed, from six-tenths to one and six-tenths per cent. of carbon, and should have no other ingredient. Wrought iron, apart from its ordinary combination with hydrogen, should be entirely free from sulphur, phosphorus, or silicon, and though for some purposes, a little manganese, tungsten, and a very small percentage of carbon may not prove disadvantageous, yet practically a pure iron is preferable to any alloy. Yet it is seldom actually free from impurities.

What is usually denominated pure iron, melts with great difficulty and only at a very much greater heat than either steel or cast iron. In actual practice it is never melted, but when the mass attains a pasty or semi-glutinous condition, it is by one process or another, either hammered, pressed, or squeezed till the impurities are forced out of it. Absolutely pure iron, *i. e.* iron free from hydrogen as well as other impurities, is one of the rarest metals in the world, and was isolated completely for the first time in 1860. It is a white metal very ductile, and tenacious and so soft as to be easily cut with a knife. The Bessemer process for eliminating the carbon both for producing wrought iron and steel, as now conducted, is as follows: A quantity of pig iron of some grade whose percentage of carbon is known, is melted in one or more reverberating furnaces, according to the size of the converting vessel to be used, which varies in capacity from five to twelve tons. When the metal becomes fluid, it is run into the converting vessel, to which is applied a strong blast of air, which combines with the carbon at an intense white heat. This is continued for about eight or ten minutes, until the whole of the carbon is consumed, when the blast is stopped. It is now wrought iron, requiring only to be squeezed or hammered to force out whatever impurities there may be in it. If, as is generally the case, it is deemed desirable to make it into the Bessemer steel or homogeneous steel or iron, as it is called on the continent, a quantity of metal, usually a pure pig iron, with a known quantity of carbon, is melted and run into the converting vessel to furnish carbon in the exact proportion to make the quality of steel desired, and this combining with the refined iron gives to the mass all the properties and characteristics of steel. This process, though practically a very rapid one, is liable to the objection which held against the old processes, that there is a time in the process of eliminating the carbon from the pig iron when the mass of iron has just enough carbon to form good steel; and that by this process that point is passed and the whole of the carbon expelled, the mass reduced to the condition of wrought iron, and then brought up to the condition of steel by the addition of a percentage of cast iron. This elimination and restoration of the carbon involves waste of time, of heat, and of iron; and hence efforts have been made to convert pig iron and iron ore into steel by a single process.

Most of the methods proposed and abiding the test of actual manufacture are intended for the reduction of pig iron or ore to steel, and so come more properly under the head of steel; but a few of them are equally applicable to the production of wrought iron.

Among these were the ingenious suggestions of a New York chemist, Prof. A. K. Eaton, at first applied to the malleable cast iron to partially decarbonize it. He proposed the use of the native carbonate of zinc as a flux to furnish the oxygen to consume the excess of carbon. The objection to this process was two-fold—that the zinc combined in a small proportion with the iron,—and that the process was too expensive to be successful. He afterward proposed to substitute crude soda-ash for the zinc—a suggestion in the right direction; for the sodium will combine with the sulphur and phosphorus, and thus help to remove the impurities from the iron; but the crude soda ash is too uncertain in its composition, too full of impurities, and does not yield its oxygen with sufficient readiness to be practically the best flux for this purpose.

The process of Messrs. Whelpley & Storer seems one of the best of the numerous American processes. The oxide of carbon, *i. e.* coal gas, half or imperfectly burned, is the grand agent for making iron and steel from all the German and English furnaces, but the great difficulty has been to apply the powerful agent in such a way as to reduce directly from the ore without going through the pig iron manufacture, the wrought or bar iron, or steel, and free it from the impurities which exist more or less in all ores as well as in much of the pig iron. Messrs. Whelpley & Storer effect this by means of a machine of their own invention, which is really nothing less than the chemist's blow pipe on a grand scale. The oxide of carbon is generated at the moment of using it upon the mass of ore, by the injection of a column of hot air carrying an excessively fine dust of coal or charcoal. The ore spread out upon the floor of a common reverberating furnace receives the red hot blast, while it is rapidly stirred by the workman, and pure iron in minute grains is produced in any desired quantity, from 100 to 2,000 pounds or more at a heat. If the mass is balled up, squeezed, and passed through roller it is bar iron of superior quality. If the time of the process is extended one hour, or even less, the iron absorbs carbon from the blast and becomes a light sponge of steel, which melts in the crucible or steel puddling furnace, and is cast into ingots of sound and pure metal. If continued still longer larger quantities of carbon are absorbed and the mass is converted into cast iron. The steel and cast iron as well as the bar iron are of superior quality, and remarkable tenacity and strength. Steel is made in this process in eight hours from crude ore to finished bar; and bar iron in little more than half that time. It is requisite to the success of the process that the carbon should be pulverized to an impalpable powder of the last degree of fineness, that thus infinitely subdivided and blown upon the mass it may carry condensed upon its surface nearly oxygen enough to consume it, and thus produce extreme rapidity, intensity, and thoroughness of combustion. This pulverization is effected, for the first time, by an ingenious machine invented by Messrs. Whelpley & Storer. What Messrs. Whelpley & Storer accomplish by their great blow-pipe and minute pulverization of carbon, Mr. C. W. Siemens effects in an entirely different way by his regenerating furnace; an apparatus requiring, in the first place, a somewhat more extensive and costly structure, but in the end accomplishing the same result of producing a rapid and intense heat and an atmosphere of oxide of carbon with a comparatively small expenditure of fuel. The necessity that the furnace linings should be almost absolutely indestructible by the intense heat generated makes the first cost of a regenerating furnace very heavy.

There are three distinct principles embodied in the Siemens' furnace, viz: the application of gaseous fuel; the regeneration of heat by means of piles of bricks alternately passed over by the waste gases and by the atmospheric air entering the furnace before their combustion; and the chemical action of these gases in combining with the impurities of the ore or the pig iron, and in modifying the quantity of carbon in combination with the iron, for the production of steel.

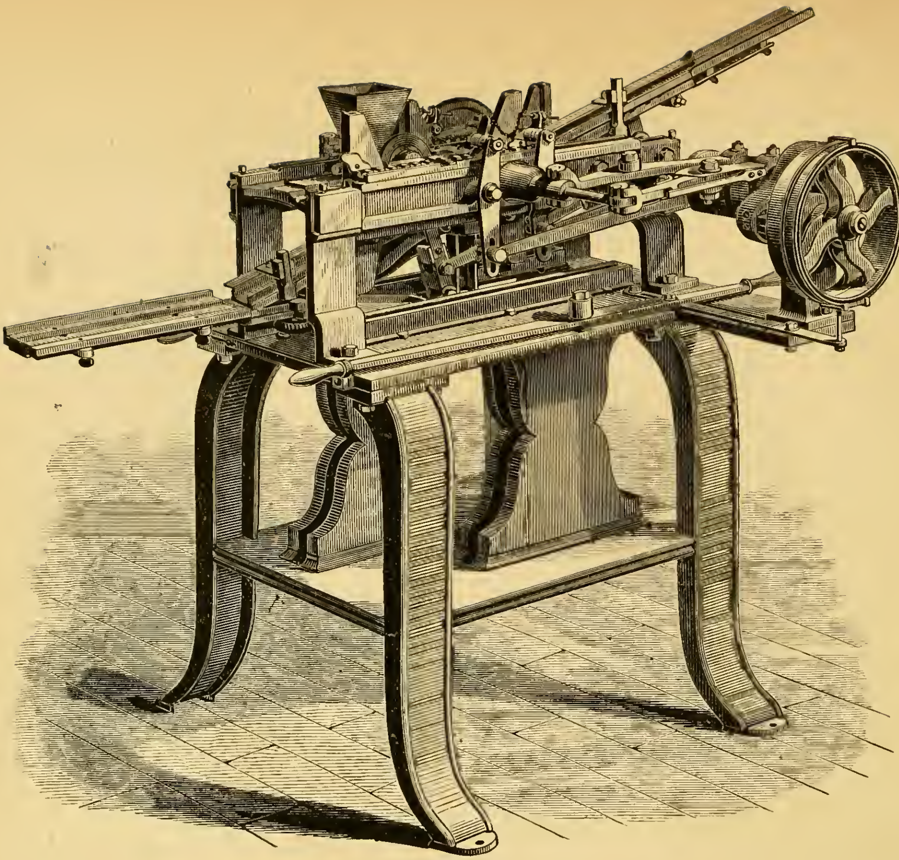
The gas producer is a brick chamber of convenient size, say six feet wide by twelve long, with its front wall inclined at an angle of 45° to 60°, according to the nature of the fuel used. The inclined plane is solid about half way down, and below this it is constructed as a grate with horizontal bars. It is what is called a base-burner, the openings for introducing the coal being on the top or roof of this chamber, and the air which enters through the grate effects the combustion of the coal at the lowest points of the chamber. The products of this combustion rise and are decomposed by the superposed strata of coal above them; they are, moreover, mixed with a quantity of steam which is drawn in through the grate from a constant supply of water maintained underneath the latter. The steam in contact with the incandescent coal also decomposes and produces hydrogen and carbonic oxide gas, which are mixed with the gases produced by the coal direct. The whole volume of these gases is then conducted to the furnace itself by means of wrought iron pipes. The gases enter one of the regenerators. The regenerators are chambers packed with fire-bricks, which are built up in walls, with interstices and air-spaces between them (cob-house fashion as we should say) allowing of a free passage of gas around each brick. Each regenerator consists of two adjoining chambers of this kind, with air-passages parallel to each other, one passage destined for the gaseous fuel, and the other for the supply of atmospheric air required for combustion. Each furnace has two such regenerators, and a set of valves is provided in the main passages or flues, which permit of directing the gases from the producer to the bottom of either of the two regenerators. The gases after passing one regenerator arrive at the furnace, where they are mixed with the air drawn in at the same time, and produce a flame of great heat and intensity within the body of the furnace itself. They then pass, after combustion, into the second regenerator which forms a set of down flues for the waste gases, and ultimately leads them off into a common chimney. On their way from the furnace to the chimney the heated products of combustion raise the temperature of the fire-bricks, over which they pass, to a very high degree, and the gases are so much cooled that, at the base of the chimney, they do not produce a temperature of much more than 300° Fahrenheit. After a certain time the fire-bricks close to the furnace obtain a temperature almost equal to that of the furnace itself, and a gradually diminishing temperature exists in the bricks of the regenerator proportionate to their distance from the furnace. At this moment the attendant, by reversing the different valves of the furnace, opens the heated regenerator for the entrance of the gaseous fuel and atmospheric air, at the same time connecting the other regenerator with the chimney for taking off the products of combustion The entire current of gases through the furnace is thus reversed. The cold air from the atmosphere, and the comparatively cold gases from the producer, in passing over bricks of gradually increasing temperature as they approach the furnace become intensely heated, and when they are mixed in the furnace itself, enter into combustion under the most favorable circumstances for the production of an intense heat, often rising to 4000° Fahrenheit in the furnace. By changing the relative proportion of air and gas admitted through the flues, the nature of the flame may be altered at will. A surplus of oxygen from the introduction of more than half the volume of atmospheric air will produce an oxidizing flame, suited to the production of very pure bar iron. By the admission of a surplus of gas, on the contrary, the flame can be made of a reductive character and used accordingly for deoxidation.

Berard's process for making steel by gas, directly from pig iron, or ore, requires the Siemens furnace, which he constructs with the bottom formed into two parts each hollowed out like a dish, with a bridge between them, upon which the pigs introduced into the furnace receive a preliminary heating. The flame is maintained with a surplus of oxygen, and a quantity of pig iron is melted in one of the chambers or dishes. The oxidizing action of the flame decarbonizes and refines the pig iron, and after a certain time a second quantity of pigs is thrown into the second dish and melted there. The flame is now reversed in its direction; the oxidizing flame is made to enter at the side where the fresh pig is placed. In passing over this, and oxidizing the carbon, silicon, and other impurities in the iron, the flame loses its surplus oxygen, and becomes of a neutral, or at least only slightly oxidizing character. In this state it passes over the other bath of molten iron, now partly refined, and it continues to act upon the impurities without attacking the iron itself. At a certain moment this portion of iron is completely converted into steel, and that part of the furnace is then tapped, so as to make room for a fresh charge of pigs in that place. After that, the current of gases is again reversed, the second bath now entering into the position previously taken by the first, and so the process is carried on continuously with two portions of iron—one freshly introduced and acted upon by the oxidizing flame, the other partly converted into steel and exposed to the neutral flame passing away from the first. M. Berard states that by protracting his process, and by adding spiegeleisen he can remove sulphur and phosphorus from the iron, and make steel from inferior pigs.

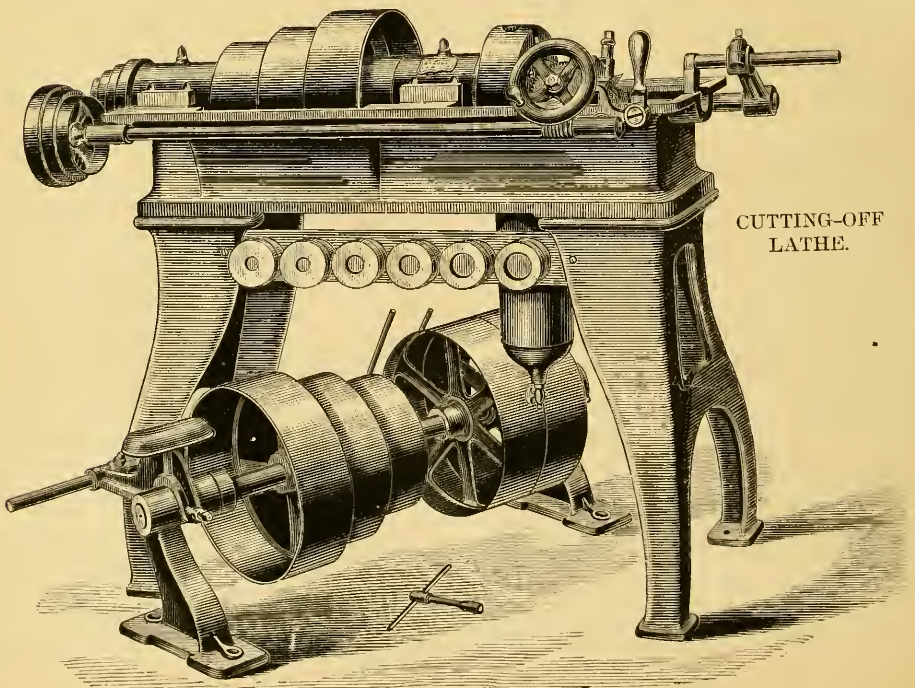
The Messrs. Martin of Sireuil, France, have, with a Siemens furnace, succeeded in melting with pig iron, old iron rails, wrought iron scrap, puddled steel, &c., in the proportion of two-thirds old rails to one-third pig iron, and have made from the compound an excellent and low-priced steel for rails.

Mr. Siemens himself patented, in 1868, and has since that time worked, a process for making natural or "raw" steel directly from the ore by means of a modification of his furnace. This can only be done successfully it is said by the use of the purest and best ores. Of other processes we may mention that of Mr. James Henderson, an eminent founder, of Brooklyn, N. Y., who, using the Bessemer process, has improved it by charging the blast furnace with a mixture of iron and manganese ores, or any of the manganiferous iron ores, thus incorporating the indispensable manganese, and causing it to exert its beneficial influence in purifying and refining the iron, at the beginning, instead of the end of the pneumatic process.

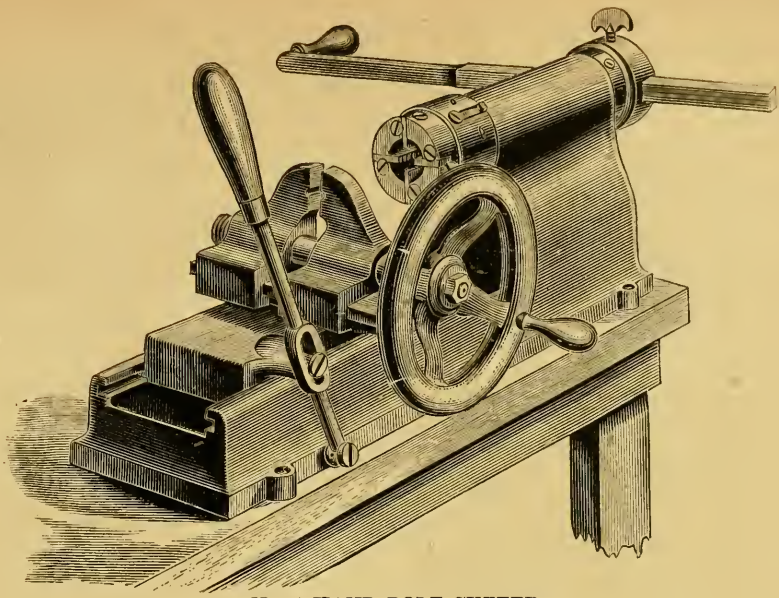
Mr. John Heaton of Nottingham, England, has been successful in oxidizing and removing the carbon and other impurities with great rapidity by the use of nitrate of soda with the molten metal in the following way: The "converter" consists of a large wrought iron pot, lined with fire clay; into the bottom of this a suitable quantity (about 6 per cent. usually of the weight of the pig iron or ore), of crude nitrate of soda combined with silicious sand, is introduced, and the whole covered with a cast-iron perforated plate. The molten pig is then poured in and in about two minutes the reaction commences; at first, brown nitrous fumes are evolved, and after a lapse of five or six minutes, a violent deflagration occurs attended with a loud roaring noise, and a burst from the top of the chimney of brilliant yellow flame, which, in about a minute and a half subsides as rapidly as it commenced. When all has become tranquil the converter is detached from the chimney and its contents emptied



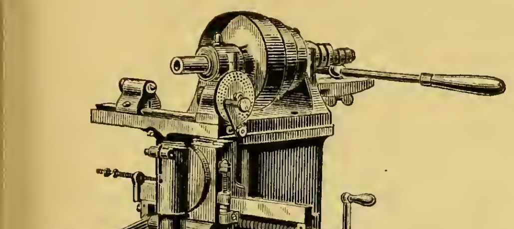
TICKETING MACHINE.



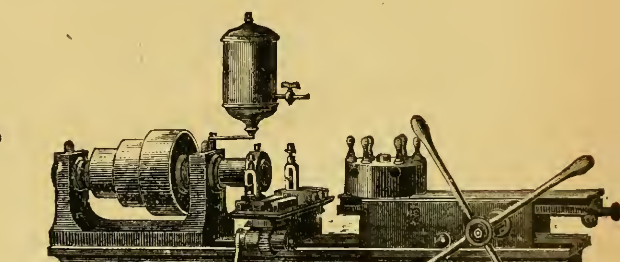
CUTTING-OFF LATHE.



No. 1 HAND BOLT-CUTTER.



INDEX MILLING MACHINE.



No. 3 SCREW MACHINE.

The Pratt & Whitney Company, Hartford, Conn.

upon the iron pavement of the foundry. The steel thus produced is pronounced by eminent metallurgists of excellent quality and practically free from impurities (the sodium combining with the sulphur and phosphorus), and it was satisfactorily demonstrated that uniformity of quality was attainable. The process is much more rapid than any other, but Mr. Bessemer asserts that the addition of the nitrate of soda makes the cost of a ton of steel about five dollars more than by his method. Mr. Hargreaves has patented a modification of this process, combining the nitrate of soda with hematite ore to form a paste, and claims that he thus obtains additional supply of oxygen. He states that he can make refined iron for puddling by the use of about 3 per cent. of nitrate of soda and six per cent. of hematite; steel by eight to ten per cent. of nitrate of soda and an equal weight of binoxide of manganese, and the best quality of wrought iron.

Mr F. Kohn, an English steel manufacturer, had, in 1868, made use of the Siemens regenerating furnace by a new process, melting a given quantity of the best and finest wrought iron in a bath of molten cast iron, carried to the highest heat of that furnace and thus making a pure steel at one heat without puddling or cementation. By his process old railroad iron, scrap iron, and scrap steel, can be converted at once into steel of the best quality for rails.

A Mr. Wilson, of Stockton-on-Tees, England, has patented a modification of the Siemens furnace which attains the same object with a still greater saving of fuel, by forcing air into the flue-bridge by a steam-jet, and causing it to pass into a conduit at the back of the furnace, and thence into the flame-bridge and up into a chamber from which, in a red-hot condition, it passes into and on to the incandescent fuel. By this improvement there is no necessity of grate-bars to the furnace, most of the fettling is saved, the steam from the heated water is at once decomposed and adds its quota to the intensity of the heat which burns up all the smoke and nearly all the cinder and slag. The saving in fuel is said to be about one-third over the Siemens furnace, and the heat is all applied directly to the removal of impurities and slag from the ores and cast iron.

The Shoenberger Junta Works, at Pittsburgh, Pa., have patented a method of making refined iron and steel by a new process which is both simple and ingenious, melting in a blast furnace a quantity of crude cast iron of whatever quality they may have, they run it into a large kettle of a capacity of five tons and thence from it in a stream about a foot wide into a circular revolving trough, twelve inches wide and ten inches deep and let fall upon the molten metal from a hopper, pulverized iron ore, Lake Superior, Champlain, or Iron mountain, in sufficient quantity to cover the melted metal as fast as it is poured in. When the trough is full, and before the iron cools, it is broken up into slabs of suitable size for a heating furnace, when it is only necessary to heat it as blooms are heated, and put it through the machinery to produce the best quality of horse-shoe bars, or by a slight variation of the process, excellent steel.

Mr. David Stewart of Kittanning, Pa., has patented a method of freeing cast iron from its carbon, sulphur, phosphorus, &c., by pouring the melted metal at full heat from a height of perhaps thirty feet in a thin stream or shower upon the ground in such a way as that it shall receive the action of atmospheric air over its entire surface, or if preferred, through a cylinder thirty feet or more in height, and open at both ends, into which air is constantly forced. He claims to have tested this process very thoroughly and to be capable of making pure iron or steel by it without puddling and without retaining any cinder or impurities. Messrs. J. R. Bradley and M. D. Brown of Chicago, Ill., patented in 1868 eight recipes of ingredients to be added to melted scrap or malleable iron which they claimed would produce in each case the precise kind of steel wanted, and of the best quality. A Mr. J. Edwin Sherman, formerly a blacksmith of Bucksport, Me., but more recently a Government clerk at Washington, D. C., is said to have hit upon a method of converting iron into steel of great simplicity and cheapness, and, in the autumn of 1870, went by invitation to England to lay his process before the lords of the Admiralty.

Among the most remarkable discoveries of the present day, in relation to the manufacture of iron, we must count those by which iron ores, hitherto regarded as worthless, have proved either by new processes or by mixture with other ores, or with cast iron, the best of all factors for producing the purest wrought iron and steel. Thus far there are two of these instances worthy of special notice. In the township of North Codorus, York Co., Pa., there are extensive beds of a peculiar micaceous iron ore; some of which were opened in 1854 or 1855, and attempts were made to make iron from them, but the ore contained but 41.5 per cent. of magnetic iron, and its reduction, owing to its peculiar combination, was attended with much labor and no profit; the ore beds were therefore abandoned. In 1868, it was discovered by accident that this unpromising ore, mixed with cast or pig iron of ordinary quality in the proportion of one to five or six in a reverberating furnace, produced by the ordinary puddling process, a pure steel of admirable quality and remarkably uniform in character. Having tested this by a very great number of experiments the discoverers purchased the Codorus ore beds, and put up a puddling furnace and rolling mill at York to carry on the business of making steel for railway rails, and other purposes. The analysis of the Codorus ore, as made by the eminent practical chemist, Otto Wurth, of Pittsburg, is as follows:

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|---|---|---|---|
| Silica, | 37.35 | Potash, | 1.87 |
| Alumina, | 3.21 | Magnetic Iron, | 41.57 |
| Manganese, | 4.45 | Peroxide of Iron, | 10.46 |
| Lime, | .74 | Water and Loss, | .35 |
| | | | 100.00 |

Further experiments, conducted under the eye of the veteran iron master, J. N. Winslow, satisfied the owners of the ore that they could safely dispense with the puddling process and produce directly from the ore and cast iron the very best quality of steel. We have ourselves examined the steel and the wrought iron produced by this combination, and in every test to which it can be subjected, whether of tenacity, tensile strength, hardness, elasticity, or capacity of receiving and retaining the highest temper, it is unsurpassed by any steel or iron known to manufacturers. Whether wrought iron and steel can be made without puddling from a combination of this ore with other ores of good quality has not yet been ascertained, but we believe that it will. By the processes at present employed, the best of steel can be made with the use of fifteen or twenty per cent. of this ore at a cost of not above $70 or $75 per ton, and possibly lower.

Of the other ore, found at Port Leyden, Lewis Co., N. Y., still more remarkable things are stated. The following account of the ores and process of reduction, made in the New York *Tribune*, is believed to be fully authenticated. The steel is certainly of excellent quality

"The discovery of an inexhaustible bed of iron ore at Port Leyden, Lewis County, about 40 miles above Utica, a few years ago, tempted citizens of the latter-named place to invest about $500,000 in the effort to establish the manufacture of iron there. The 'Port Leyden Iron Works' were a sad failure, and the entire amount of money invested in them was lost, as pig iron could not be produced from the ore. From this impracticable ore, steel is now produced, at one fusion, by a process invented by Prof. E. L. Seymour, a metallurgist and chemist, who resides in this vicinity. The outlines of the process are as follows: The ore is crushed, in something like an ordinary quartz-crusher, until it is reduced to about the fineness of rifle powder. It is then thrown into a revolving cylinder, in which are set numerous magnets. The ore is of the kind known as 'magnetic.' By an arrangement of small brushes, the metallic particles are separated from the refuse, which is principally stony and earthy matter in the shape of fine dust. The application of certain chemicals and fusion by charcoal are the next steps in the process, and the immediate product is pure steel, ready for molding into 'ingots. Specimens of steel thus manufactured and converted into finely-tempered table cutlery, and other articles, and the certificate of a well-known cutler of Brooklyn, who made the articles, that it is as good steel as he ever worked, and adapted to all cutlery purposes, have been exhibited. The estimated cost of this steel is less than four cents. By the Seymour process, it is claimed that the aim of iron-masters and chemists for the last 200 years is accomplished—viz: to rid iron of its arch enemies, sulphur and phosphorus—the former rendering the metal what is technically called 'red-short,' so that it flies to pieces under the hammer when at a red heat, though it may be quite strong when cold; while the least quantity of phosphorus renders the metal 'cold-short,' making it weak and brittle when cold, though quite strong when hot.

"The Port Leyden Works are about one-eighth of a mile from the railroad and the canal. The buildings, furnaces, etc., were erected several years ago at great expense; and for some time there have lain in the forest near by nearly 100,000 bushels of charcoal, the overplus of what was made before it was found that iron could not be produced from the ore by the old processes."

It has recently been discovered that there are extensive veins of a peculiar coal, called block coal in Indiana, which is remarkably adapted to the production of the best iron. In its constituents and its working, it is very nearly a pure charcoal and containing neither sulphur nor phosphorus, it does not impart to iron in the smelting process any ingredient which impairs its value. These veins of block coal are of great thickness, and extend widely over the central and southern part of the state. It has not thus far been discovered in any other state. Indiana has no great variety of iron ores, but her railroad facilities present, and prospective, for bringing the Missouri ores from Pilot Knob and Iron Mountain and the rich specular ores from the Lake Superior region in Michigan, are such that with this excellent coal, her citizens can manufacture the finest qualities of iron and steel at considerably lower prices than they can be produced for, elsewhere. As a consequence numerous furnaces were erected in 1870 and 1871, along the line of the block coal veins, and many more are now going up. The improved process and new discoveries to which we have alluded, while they will materially reduce the cost of making steel, have also so far reduced the cost of making iron, that the reduction of ten per cent. on iron and iron manufactures in the new tariff of 1872, only stimulated the manufactures, after the panic of 1873 had spent its force, to new exertions, and there has been an enormous increase in the production of both iron and steel. The amount of pig iron made in the U. S. in 1880 was 3,781,021 tons, an increase of 84 per cent on 1870, and of the products of iron rolling mills in 1880 2,353,248 tons, an increase of 63 per cent. on 1870. Total iron produced in 1880, 6,134,269 tons, against 3,494,650 tons in 1870.

In 1870 the quantity of old iron rails rerolled made it difficult to determine how many new rails were actually produced; but in 1880, old rails (both iron and steel) were counted only as material. In that year 708,534 tons of old iron rails were used in the production of 2,453,248 tons of rolled iron, and 466,917 tons of new iron rails were made; 85,653 tons of old steel rails, etc., were used as material, and 750,580 tons of new steel rails were made.

Sheet Iron.—For making sheet iron the bars are gradually spread out between smooth rolls, which are brought nearer together as the metal grows thinner. The Russians have a method of giving to sheet iron a beautifully polished surface, and a pliability and durability which no other people have been able to imitate. All attempts that have been made to learn the secret of this process have entirely failed, and the business remains a monopoly with the Russians. The nearest imitation of this iron is produced at Pittsburg, Pennsylvania, and several eastern establishments, by what is called Wood's process. This consists in rolling the common sheet at a certain temperature while it is covered with linseed oil. A very fine surface is thus produced, but the pliability and toughness of the Russian iron are wanting, even though the sheets are often annealed in close vessels, and the glaze and color are also inferior. Sheet iron is now extensively prepared for roofing, and other uses requiring exposure to the weather, by protecting its surface with a coating of zinc. This application is an American invention, having been discovered in 1827, by the late Prof. John W. Revere, of New York. In March, 1859, he exhibited, at a meeting of the Lyceum of Natural History, specimens of iron thus protected, which had been exposed for two years to the action of salt water without rusting. He recommended it as a means of protecting the iron fastenings of ships, and introduced the process into Great Britain. Sheets thus coated are known as galvanized iron, though the iron is now coated with zinc by other means as well as by the galvanic current. One method, that of Mallet, is to place the sheets, after they are well cleaned by acid and scrubbed with emery and sand, in a saturated solution of hydrochlorate of zinc and sulphate of ammonia; and after this in a bath composed of 202 parts of mercury and 1,292 of zinc, to every ton weight of which a pound of potassium or sodium is added. The compound fuses at 680° Fahrenheit, and the zinc is immediately deposited upon the iron surface. Another method is to stir the sheets in a bath of melted zinc, the surface of which is covered with sal ammoniac.

The use of heavy sheets or plates for building purposes is also a recent application of iron, that adds considerably to the demand for the metal. The plates are stiffened by the fluting, or corrugating, which they receive in a powerful machine, and may be protected by a coating of zinc. Their preparation is largely carried on in Philadelphia; and in the same works a great variety of other articles of malleable iron, for domestic and other uses, are similarly protected with zinc, as window shutters, water and gas pipes, coal scuttles, chains for pumps, bolts for ships' use, hoop iron, and telegraph and other wire.

The production of sheet iron in 1870 was 74,753 tons; in 1880, 94,992 tons; of all kinds of plate iron in 1870, 284,702 tons were made; in 1880, there were 437,139 tons, an increase of more than 50 per cent.

This great increase was due to several causes, among which may be enumerated its use in the construction of coasting and other steamers, the large consumption of corrugated plate iron in the construction of churches, warehouses, and stores, and also in the construction of machines for manufacturing and household uses. The 1,000,000 sewing machines made in this country in 1880, and the hundreds of agricultural machines produced the same year, consumed a large quantity of plate iron; certainly not less than 90,000 tons.

Iron Wire.—The uses of iron wire have greatly increased within a few years past. The telegraph has created a large demand for it; and with the demand the manufacture has been so much improved, especially in this country, that the wire has been found applicable to many purposes for which brass or copper wire was before required. It is prepared from small rods, which are passed through a succession of holes, of decreasing sizes, made in steel plates, the wire being annealed as often as may be necessary to prevent its becoming brittle. In this branch the American manufacturers have attained the highest perfection. The iron prepared from our magnetic and specular ore is unequalled in the combined qualities of strength and flexibility, and is used almost exclusively for purposes in which these qualities are essential. But where stiffness combined with strength is more important, Swedish and Norwegian iron also are used. Much of the iron wire now made is almost as pliable as copper wire, while its strength is about 50 per cent. greater. In Worcester, Mass., a large contract has been satisfactorily filled for No. 10 wire, one of the conditions of which was that the wire, when cold, might be tightly wound around another wire of the same size without cracking or becoming rough on the surface. Such wire is an excellent material for ropes, and considerable American iron is already required for this use, especially for suspension bridges. Wires are also used for fences, and are ingeniously woven into ornamental patterns. The so-called "netting fence," thus made, can be rolled up like a carpet. For heavier railing and fences, as for the front yards of houses, for balconies, window guards, etc., iron bars and rods are now worked into ornamental open designs, by powerfully crimping them and weaving them together like wires.

Nails.—Among the multitude of other important applications of malleable iron, that of nail making is particularly worthy of notice, as being in the machine branch of it—the preparation of cut nails—entirely an American process. Our advance in this department is ascribed to the great demand for nails among us in the construction of wooden houses. In England, even into the present century, nails were wrought only by hand, employing a large population. In the vicinity of Birmingham it was estimated that 60,000 persons were occupied wholly in nail making. Females and children, as well as men, worked in the shop, forging the nails upon anvils, from the "split iron rods" furnished for the purpose from the neighboring iron works. The contrast is very striking between their operations and those of the great establishments in Pennsylvania, consisting of the blast furnaces, in which the ores are converted into pig; of the puddling furnaces, in which this is made into wrought iron; of the rolling and slitting mills, by which the malleable iron is made into nail-plates; and of the nail machines, which cut up the plates and turn them into nails—all going on consecutively under the same roof, and not allowing time for the iron to cool until it is in the finished state, and single establishments producing more nails than the greater part of the workshops of Birmingham fifty years ago. Public attention was directed to machine-made nails as long ago as 1810, by a report of the secretary of the treasury, in which he referred to the success already attained in their manufacture in Massachusetts. "Twenty years ago," he states, "some men, now unknown, then in obscurity, began by cutting slices out of old hoops, and, by a common vice gripping these pieces, headed them with several strokes of the hammer. By progressive improvements, slitting mills were built, and the shears and the heading tools were perfected, yet much

THE TIME REQUIRED TO ROLL A R. ROAD RAIL FROM 20 TO 30 FEET LONG, AND TO SAW OFF THE ENDS TO PROPER LENGTH, IS FROM $1\frac{1}{4}$ TO 2 MINUTES.

labor and expense were requisite to make nails. In a little time, Jacob Perkins, Jonathan Ellis, and a few others, put into execution the thought of cutting and of heading nails by water; but being more intent upon their machinery than upon their pecuniary affairs, they were unable to prosecute the business. At different times other men have spent fortunes in improvements, and it may be said with truth that more than a million of dollars have been expended; but at length these joint efforts are crowned with complete success, and we are now able to manufacture, at about one-third of the expense that wrought nails can be manufactured for, nails which are superior to them for at least three-fourths of the purposes to which nails are applied, and for most of those purposes they are full as good. The machines made use of by Odiorne, those invented by Jonathan Ellis, and a few others, present very fine specimens of American genius." The report then describes the peculiar character of the cut nail—that it was used by northern carpenters without their having to bore a hole to prevent its splitting the wood; that it would penetrate harder wood than the wrought nail, etc. At that time, it states, there were twelve rolling and slitting mills in Massachusetts, chiefly employed in rolling nail plates, making nail rods, hoops, tires, sheet iron, and copper, and turning out about 3,500 tons, of which about 2,400 tons were cut up into nails and brads. That State still leads in this manufacture, having in 1870, 49 out of 142 establishments in the whole country, more than one-fourth of the capital and more than one-fifth of the annual products. The smaller establishments are gradually going out of the business, and this is becoming more concentrated in the coal and iron regions, thus saving the cost of transportation in these heavy articles. The manufacturers of New England, however, ingeniously divert a part of their operations to the production of smaller articles, with which the cost of transportation is a less item in proportion to their value, such as tacks, rivets, screws, butts, wire, and numerous finished articles, the value of which consists more in the labor performed upon them and in the use of ingenious machinery than in the cost of the crude materials employed.

The statistics of the nail, spike, tack, and brad business in 1880 have not yet been published, but in 1870 there were 142 establishments, of which 119 were confined to nails and tacks alone. These nail mills employed 7,770 hands, of whom 6,062 were men, 381 women, 1,327 children; the capital used was $9,091,912. They used about 250,000 tons of wrought iron, and other material valued in all at $18,792,383; paid wages to the amount of $3,961,172, and produced goods to the annual value of $24,823,996. Massachusetts, Pennsylvania, New York, West Virginia, New Jersey, and Ohio were the only States largely engaged in the business. The weight of cut nails produced in 1880 was 252,830 tons, or 5,056,600 kegs. The demand for the larger sizes has greatly diminished bolts of iron, bronze or copper having been substituted for them, and being safer from the readiness with which they are riveted.

A great variety of machines have been devised for nail making, very ingenious in their designs, and all too complicated for description. The iron is rolled out into bars for this manufacture, of 10 or 12 feet in length, and wide enough to make three or more strips, each one of which is as wide as the length of the nail it is to make. The cutting of these strips from the wider bars is the special work of the slitting mill, which is, in fact, but a branch of the rolling operation, and carried on in conjunction with it. The slitting machine consists of a pair of rolls, one above the other, each having 5 or 6 steel disks upon its axis, set as far apart as the width required for the nail-rod. Those upon one roll interlock with those upon the other, so that when the wide bar is introduced it is pressed into the grooves above and below, and cut into as many strips as there are spaces between the disks. This work is done with wonderful rapidity, several bars being passed through at once. In the nail factory each nail-making machine works upon one of these strips, or nail-rods, at a time, first clipping off a piece from the end presented to it, and immediately another, as the flat rod is turned over and the end is again presented to the cutter. The reason of turning it over for each successive cut is because the piece cut off for the nail is tapering, in order to make it a little wider at the end intended for the head than at the other, and thus, making the wider cut on alternate sides of the rod, this is regularly worked up into pieces of the proper shape. In the older operations a workman always sat in front of each machine, holding the rod and turning it over with every clip; but by a modern improvement this work is also done by mechanical contrivance. Each piece, as fast as it is clipped off, disappears in the machine. There it is seized between powerful jaws, and the head is pressed up from the large end by the short, powerful motion imparted to the piece of apparatus called the header. As it is released, it slides down and drops upon the floor, or in a vessel placed to receive the nails.

Machinery has been applied in the United States to the manufacture of horse-shoe nails, according to a number of patented plans. Of these, the most successful is probably that invented about the year 1848, by Mr. L. G. Reynolds, of Providence; also the inventor of the solid-headed pin. The form of this nail could not be given as in ordinary cut nails by the cutter, but the sides required to be pressed as well as the head. This involved the use of movable plates of suitable figure; and as it was found that the nails could not be shaped except when the metal was softened by heat, the plates must necessarily be of the hardest steel, and protected as effectually as possible from the effects of constant working of heated iron. These difficulties were fully overcome, and the nails, after being turned out, were toughened by annealing, giving them all the excellent qualities of hand-made nails, with the advantage of perfect uniformity of size, so that one nail answers as well as another for the holes in the horse-shoes. They are, moreover, made with great rapidity, each machine producing half a ton of nails in 12 hours. The process has been taken to Europe, and is there in successful operation. Spikes, also, have been made and headed in similar machines; and among all small articles in iron, none, perhaps, has proved so profitable to the inventor as the hook-headed spike, used for holding down, by its projecting head, the edge of the iron rails to the sill. This was the invention of Mr. Henry Burden, of Troy, whose machines for wrought-iron spikes and for horse-shoes have also proved very successful. By the latter, perfect shoes are turned out at the rate of 60 in a minute. This process has been introduced in most of the European countries.

### STEEL.

As already remarked, steel differs in composition from metallic iron only by containing from ½ to 1½ per cent. of carbon, and from cast-iron by the latter containing a larger proportion of carbon, which may amount to 5.5 per cent. To readily convert these varieties into each other is an object of no small importance, for their properties are so entirely distinct, that they really serve the purposes of three different metals. Steel is particularly valuable for its extreme hardness, fine grain, and compact texture, which admits of its receiving a high polish. It is the most elastic of metals, and much less liable to rust than iron. It has the peculiar property of assuming different degrees of hardness, according to the rapidity with which it is chilled when heated; and it may be melted and run into moulds like cast iron, and the ingots thus prepared may be hammered, rolled, and forged into shapes like wrought iron; and these may finally be tempered to any degree of hardness desired. Differing so little in composition from metallic iron and from cast iron, and being so universally in demand for a multitude of uses, it would seem that it ought to be produced as cheaply as one or the other of the varieties, between which its composition places it. But this is far from being the case. While pig iron is worth only $23 to $30 per ton, and bar iron $46 to $76, steel rails are worth from $60 to $88 per ton, and steel bars or ingots from $150 to $200 per ton. This is chiefly owing to the difficulty of procuring in large quantities steel of uniform character, which the consumers of the article can purchase with perfect confidence that it is what they require and have been accustomed to use. The English, though producing themselves little or no iron fit for making alone the best steel, imported enough of the Swedish and Norwegian bar iron to insure a good quality, and were especially cautious to render this as uniform as possible. Of late years, however, their ingot has not been superior to the American. Their method of manufacture is to introduce carbon into the wrought iron by what is called the cementing process. On the continent of Europe steel is made to some extent, in Silesia and Styria, by removing from cast iron enough of its carbon to leave the proper proportion for steel, and then melting the product and casting it into ingot moulds. But this cheaper method does not appear to have been taken up in Great Britain. In the United States several processes are in operation, two of which are peculiarly American. The cementing method, as conducted in England, has been longest known, and will be first described. The cementing furnace is a sort of oven, furnished with troughs or shelves, upon which charcoal dust is laid for receiving the bars. These are placed edgewise in the charcoal, half an inch apart, and the spaces are filled in with more sifted coal. Enough is added to cover the bars, and upon this a second tier is laid in the same way, and so on till the trough is filled with several tons of iron, all of which is perfectly excluded from the air. The trough being secured with others in the oven, a fire is started under them. In about six days the bars have absorbed enough carbon to acquire the properties of the softer kinds of steel, such as are used for saws and springs. In a day or two longer it answers for cutting instruments, and some time after this it gains in hardness, so as to be fitted for cold chisels, for drills such as miners use, etc. Its character is ascertained at any time by drawing out one of the bars. After the change is effected the fire is extinguished, and about a week is allowed for the furnace and its contents to cool. When at last the bars are obtained, their surface is found to be covered with blisters, whence the steel is called blistered steel. The fibrous texture of the iron has given place to a granular structure, but is so irregular and uneven that the metal requires further treatment to perfect it. To make the English shear-steel, so called from its being originally employed for shears used in sheep-shearing, the bars are cut into lengths of a foot and a half, and a number of these are bound together to make a faggot. This is brought to a welding heat, and drawn down first under a forge-hammer, and then under the tilt-hammer. This weighs from 150 to 200 pounds, and strikes from 150 to 360 strokes a minute. The rapidity of the work keeps the steel at a glowing heat, and it is soon fashioned into a dense bar of smooth surface, susceptible of a polish, and suited for the manufacture of cutting instruments. Sometimes it is cut into pieces to be refaggoted, and drawn down again into bars, which are then called double-shear.

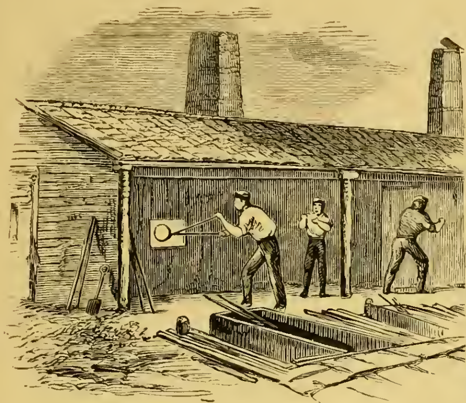
Cast steel is a still more dense and perfect variety. It is prepared by melting, in large crucibles, blistered steel broken into small pieces, and pouring the metal into moulds. These are then worked into shapes by the forge hammer and the rolls.

One of the most approved American methods of making steel was discovered by Prof. A. K. Eaton, of New York, before 1850, and was practically demonstrated by him in Rochester and its vicinity in 1851 and 1852. This consisted in carbonizing and melting malleable iron in crucibles at one operation, by introducing into the pot with the pieces of iron a carbonaceous salt, such as the ferro-cyanide of potassium, either alone or in combination with charcoal powder. At an intense heat this salt rapidly carbonizes the iron, which thus first becomes steel, then fuses, and is poured into moulds. The quantity of the salt employed is proportional to the quantity of the iron and the quality of the steel required. The operation is successfully carried on in different establishments in New Jersey, New York, and Pennsylvania, and cast steel of the very best quality is produced at less expense than the article has ever before cost in this country. For bar steel, according to the prospectus of the company, the best charcoal-made iron is employed, costing $85 per ton, and this, together with the coal used for fuel, the chemical materials, the melting, crucibles, and hammering, make the whole cost about $142 per ton, while that of the imported article is $300 or more. The great difficulty in the process is to obtain suitable crucibles for withstanding the intense heat required to melt the charge of 60 lbs. of malleable iron. Those in use are blue-pots, costing $1.60 each. Though made of the best of plumbago, they stand only two or three meltings.

The other process, which was introduced into practice in 1859, is based upon the property of carbonate of soda to remove from cast iron the carbon it contains, when the metal is kept for a few hours in a bath of the melted alkali. The decarbonizing effect is in part due to the action of the oxygen of the alkaline base, which is given up to the carbon of highly heated cast iron, but principally to the decomposition of the combined carbonic acid, which gives to the carbon one of its atoms of oxygen, and is resolved into carbonic oxide. This property of soda was discovered by Prof. Eaton in 1856, but the fact that the carbonated or bicarbonated alkalies act principally by virtue of their carbonic acid, was only recently recognized and made practically available by him. The action of soda or its carbonates is not limited to the removal of the excess of carbon in cast iron. It combines with and removes those impurities which would prove fatal to the quality of the steel if remaining in it, as sulphur, phosphorous, and silicon; and the method thus admits of the use of crude irons, such as could never be applied to this manufacture by any other mode. The cast iron, in the form of thin plates, having been kept at a bright red heat in the bath of melted carbonate for a sufficient time, which is determined by occasionally taking out and testing some of the pieces, is transferred to the crucible, and is then melted and poured into moulds, as in the ordinary method of making cast steel. The crucibles endure much longer than when employed for melting wrought iron in the carbonizing process; thus a great saving is effected in the expense of the conversion; and this economy is still further increased by the use of a crude material, costing only from $6 to $10 per ton, in place of the superior qualities of wrought iron, worth $85 per ton. So great, indeed, is the saving, that the cost of the cast steel, when obtained in ingots, is found not to exceed the cost of the malleable iron employed in the other process. Later processes have effected these results still more successfully.

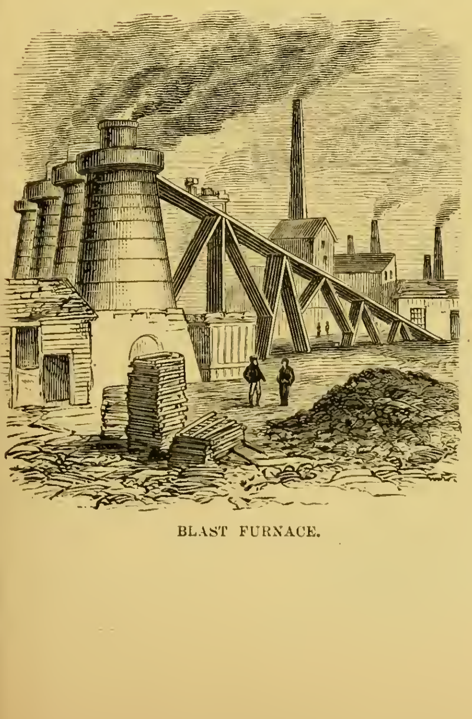
STATISTICS.—The records of the production of iron of the United States are very incomplete up to the year 1854. Even the census returns are highly defective, as they often make no distinction between iron made from the ore and the products of the secondary operations of remelting and puddling. The first systematic attempts to obtain complete accounts of the business, as conducted in Pennsylvania, were made in 1850 by the Association of Iron Manufacturers, organized in Philadelphia. Mr. Charles E. Smith collected the returns, and published them in a small volume, together with other papers relating to the manufacture. The published statistics of 1856 are the first which were at all full or complete; since that time there have been more frequent reports; those of 1873 and 1880 being especially complete. We give the three reports of these years, to show the progress which has been made in 24 years.

| 1856. | Blast Furnaces. | | | | | | | | 1873. Blast Furnaces. | | | | | | | | 1880. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| States. | Charcoal. | Anthracite. | Bituminous Coal. | Coke. | Blooming Forges. | Finery Forges. | Rolling Mills. | Steel Works. | Charcoal. | Anthracite. | Bituminous and Block Coal, with Coke. | Blooming Forges. | Finery Forges. | Rolling Mills. | Steel Works. | Bessemer Steel Works. | Total Number of Establishments. | Number of Hands Employed. | Wages Paid in all the Works. |
| Maine | 1 | .. | .. | .. | .. | ... | 1 | .. | 1 | .. | .. | .. | .. | 2 | .. | .. | 3 | 700 | $141,494 |
| N. Hampshire | 5* | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | 1 | .. | 2 | 290 | 127.690 |
| Vermont | 1 | .. | .. | .. | 5 | .. | 1 | .. | 2 | .. | .. | 2 | .. | 1 | .. | .. | 4 | 191 | 50.035 |
| Massachusetts | 7 | 3 | .. | .. | .. | 5 | 19 | .. | 5 | 1 | .. | .. | 1 | 24 | 3 | .. | 30 | 6,513 | 2,576.539 |
| Rhode Island | .. | .. | .. | .. | .. | .. | 2 | .. | . | .. | .. | .. | .. | 2 | 1 | .. | 3 | 275 | 130,969 |
| Connecticut | 14 | 1 | .. | .. | .. | 6 | 5 | 2† | 10 | .. | .. | .. | .. | 9 | 4 | .. | 19 | 685 | 331.184 |
| New York | 29 | 14 | .. | .. | 42 | 3 | 13 | .. | 17 | 36 | .. | 28 | .. | 26 | 6 | 1 | 89 | 11,444 | 4.099.451 |
| New Jersey | 6 | 4 | .. | .. | 48 | 2 | 10 | .. | . | 13 | .. | .. | 3 | 18 | 7 | .. | 40 | 4,792 | 1,808,448 |
| Pennsylvania | 143 | 93 | 6 | 21 | .. | 111 | 91 | 8† | 39 | 139 | 74 | .. | 31 | 131 | 19 | 5 | 366 | 57.952 | 25.095 850 |
| Delaware | .. | .. | .. | .. | .. | .. | 4 | .. | .. | .. | .. | .. | .. | 8 | .. | .. | 9 | 867 | 344.476 |
| Maryl'd & D. C. | 21 | 6 | .. | 3 | .. | 2 | 13 | .. | 14 | 4 | 4 | .. | 1 | 6 | 1 | .. | 24 | 2.781 | 912.618 |
| Virginia | 39 | .. | .. | .. | .. | 43 | 12 | .. | 34 | 1 | .. | .. | 5 | 4 | .. | .. | 44 | 2,522 | 665,432 |
| West Virginia | .. | .. | .. | .. | . | .. | .. | .. | 4 | .. | 2 | 7 | 1 | 8 | .. | .. | 20 | 4,121 | 1,541.816 |
| North Carolina | 3 | .. | .. | .. | 36 | .. | 1 | .. | 8 | .. | .. | .. | 1 | .. | .. | .. | 20 | 63 | 7,907 |
| South Carolina | 4 | .. | .. | .. | 2 | .. | 3 | . | 8 | .. | .. | . | .. | 2 | .. | .. | .... | ..... | ......... |
| Georgia | 7 | .. | .. | .. | 4 | .. | 1 | .. | 8 | .. | .. | .. | .. | 2 | .. | .. | 14 | 1,303 | 185.489 |
| Alabama | 3 | .. | .. | .. | 14 | : | .. | .. | 11 | .. | . | .. | .. | 2 | .. | .. | 14 | 1,626 | 571,713 |
| Tennessee | 41 | .. | .. | .. | 50 | 9 | 3 | .. | 17 | .. | 3 | .. | 1 | 4 | .. | .. | 43 | 3.077 | 659.773 |
| Kentucky | 30 | .. | .. | .. | .. | 4 | 7 | .. | 22 | .. | 3 | .. | .. | 11 | 1 | .. | 29 | 4.095 | 1,344.400 |
| Ohio | 41 | .. | 13 | .. | .. | .. | 15 | .. | 37 | .. | 51 | .. | .. | 44 | 7 | 1 | 134 | 20,071 | 8,265,070 |
| Indiana | 2 | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 8 | .. | .. | 11 | .. | .. | 12 | 2.048 | 864,921 |
| Illinois | 2 | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 10 | .. | .. | 8 | 1 | 3 | 21 | 5.253 | 2,508,718 |
| Michigan | 7 | .. | .. | .. | 3 | .. | 2 | .. | 29 | 1 | 3 | .. | .. | 4 | .. | .. | 22 | 3,089 | 922.597 |
| Wisconsin | 3 | .. | .. | .. | .. | .. | .. | .. | 10 | 3 | .. | .. | .. | 1 | .. | .. | 9 | 2,153 | 1,004.931 |
| Minnesota | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 180 | 25.275 |
| Missouri | 7 | .. | .. | .. | .. | 3 | 4 | .. | 9 | .. | 9 | .. | .. | 7 | .. | .. | 22 | 3,139 | 734,575 |
| Oregon | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | 3 | .. | .. | .. | .... | 250 | 46.822 |
| Kansas | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | 2 | 630 | 166,500 |
| Texas | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | .. | .. | .. | .. | .. | 1 | 140 | 27,720 |
| Utah T. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | 3 | ..... | .......... |
| Colorado | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 125 | 7,000 |
| California | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | .. | .. | 1 | 319 | 177,722 |
| Nebraska | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 100 | 50,000 |
| Wyoming T. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | 184 | 79.650 |
| | 416 | 121 | 19 | 24 | 204 | 189 | 209 | 10 | 287 | 208 | 167 | 37 | 47 | 339 | 51 | 10 | 1,005 | 140,978 | $55,476,785 |

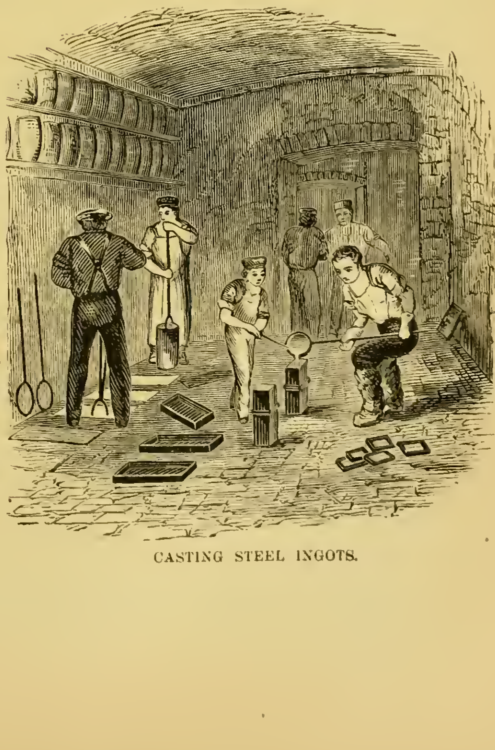


PUDDLING.

CASTING PIG IRON.



BLAST FURNACE.



CASTING STEEL INGOTS.

| States. | 1856. Pig Iron of all Kinds Made. Tons. | 1856. Wrought Iron and Steel of all Kinds. Tons. | 1873. Pig Iron of all Kinds. Tons. | 1873. Wrought Iron and Steel, Including Steel Rails of all Kinds. Tons. | 1880. Pig Iron of all Kinds. | 1880. Rolled Iron. | 1880. Steel of all Kinds. | 1880. Blooms of all Kinds. | 1880. Total Production of Rails of all Kinds. | 1870. Weight of all Iron Products in 1870. | 1870. Value of all Iron Products in 1870. | 1880. Weight of all Iron Products in 1880. Tons. | 1880. Value of all Iron Products in 1880. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maine | 2,100 | 4,500 | 780 | 21,210 | 2,015 | 8,851 | ...... | ...... | ...... | 17,138 | | 10,866 | $583,328 |
| N. Hampshire | ...... | 600 | ...... | 300 | ...... | 4,752 | 4,521 | ...... | ...... | ...... | | 7,978 | 807,340 |
| Vermont | 2,420 | 2,150 | 3,100 | 6,788 | 620 | 1,500 | 3,000 | ...... | 6,000 | 1,525 | | 6,620 | 392,300 |
| Massachusetts | 13,007 | 57,142 | 21,136 | 118,669 | 9,543 | 109,252 | 9,615 | 44 | 5,600 | 86,146 | | 141,321 | 10,288,921 |
| Rhode Island | ...... | 4,475 | ...... | 11,662 | ...... | 8,134 | ...... | ...... | ...... | 4,415 | | 8,134 | 488,040 |
| Connecticut | 12,876 | 7,709 | 26,977 | 11,409 | 18,779 | 16,203 | 2,116 | ...... | ...... | 25,305 | | 38,061 | 1,998,698 |
| New York | 69,031 | 75,242 | 296,818 | 186,835 | 313,308 | 163,538 | 86,745 | 31,718 | 92,175 | 448,257 | | 598,300 | 22,219,219 |
| New Jersey | 28,217 | 33,561 | 102,341 | 77,688 | 157,414 | 66,030 | 10,942 | 3,829 | ...... | 115,262 | | 243,860 | 10,341,896 |
| Pennsylvania | 451,496 | 273,211 | 1,389,573 | 858,946 | 1,930,311 | 1,071,098 | 656,696 | 24,573 | 569,912 | 1,836,808 | | 3,616,668 | 145,576,268 |
| Delaware | ...... | 2,211 | ...... | 11,617 | ...... | 33,918 | ...... | ...... | ...... | 8,307 | | 33,918 | 2,347,117 |
| Maryl'd & D.C. | 41,718 | 15,292 | 55,986 | 58,025 | 59,264 | 47,873 | ...... | 3,661 | 9,280 | 95,424 | | 111,198 | 4,481,020 |
| Virginia | 14,828 | 29,350 | 26,475 | 15,608 | 17,906 | 35,176 | ...... | 2,640 | ...... | 37,836 | | 55,722 | 2,585,999 |
| West Virginia | ...... | ...... | 23,056 | 51,796 | 80,050 | 67,437 | ...... | ...... | 3,333 | 72,337 | | 147,487 | 6,054,032 |
| North Carolina | 450 | 1,397 | 1,432 | 110 | ...... | ...... | ...... | 439 | ...... | 1,801 | | 439 | 41,085 |
| South Carolina | 1,506 | 1,850 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | 443 | | ...... | ...... |
| Georgia | 2,807 | 940 | 7,501 | 10,624 | 23,099 | 31,501 | ...... | 552 | 8,673 | 9,634 | | 35,152 | 990,850 |
| Alabama | 1,495 | 252 | 22,283 | 500 | 62,336 | 650 | ...... | ...... | ...... | 7,060 | | 62,986 | 1,452,856 |
| Tennessee | 28,476 | 10,097 | 43,134 | 16,561 | 47,873 | 25,381 | 4,000 | 1,101 | 15,545 | 31,305 | | 77,100 | 2,274,203 |
| Kentucky | 36,563 | 21,376 | 69,889 | 39,060 | 58,108 | 65,293 | 350 | ...... | 18,000 | 86,732 | | 123,751 | 5,090,029 |
| Ohio | 87,011 | 30,980 | 406,029 | 272,066 | 548,712 | 272,094 | 109,883 | ...... | 108,318 | 449,768 | | 930,141 | 34,918,360 |
| Indiana | 1,800 | ...... | 32,486 | 36,006 | 18,237 | 77,880 | ...... | ...... | 38,600 | 64,148 | | 96,117 | 4,551,403 |
| Illinois | 1,900 | ...... | 55,796 | 143,017 | 95,468 | 117,051 | 254,569 | ...... | 273,988 | 25,761 | | 417,967 | 20,545,289 |
| Michigan | 3 678 | 2,298 | 123,506 | 8,542 | 119,586 | 23,130 | ...... | ...... | ...... | 86,679 | | 142,716 | 4,591,613 |
| Wisconsin | 2,500 | ...... | 74,148 | 39,495 | 118,282 | 60,653 | ...... | ...... | 29,552 | 42,234 | | 178,905 | 6,580,931 |
| Minnesota | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | | ...... | ...... |
| Missouri | 10,138 | 5,325 | 85,552 | 25,055 | 95,050 | 16,508 | 8,409 | 4,000 | 5,100 | 94,890 | | 125,758 | 4,660,530 |
| Oregon | ...... | ...... | ...... | ...... | 3,200 | ...... | ...... | ...... | ...... | ...... | | 3,200 | 783,910 |
| Kansas | ...... | ...... | ...... | ...... | ...... | 19,055 | ...... | ...... | 13,500 | ...... | | 19,055 | 1,004,100 |
| Texas | ...... | ...... | 280 | ...... | 1,400 | ...... | ...... | ...... | ...... | ...... | | 1,400 | 36,000 |
| Utah T. | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... | | ...... | ...... |
| Colorado | ...... | ...... | ...... | ...... | ...... | 4,500 | ...... | ...... | 4,500 | ...... | | 4,500 | 225,000 |
| California | ...... | ...... | ...... | 7,420 | ...... | 14,000 | ...... | ...... | 6,000 | 3,000 | | 14,000 | 780,000 |
| Nebraska | ...... | ...... | ...... | ...... | ...... | 2,000 | ...... | ...... | ...... | ...... | | 2,000 | 82,000 |
| Wyoming T. | ...... | ...... | ...... | ...... | ...... | 9,790 | ...... | ...... | 9,421 | ...... | | 9,790 | 491,345 |
| | | | 2,868,278 | 2,029,009 | 3,781,021 | 2,353,248 | 1,148,846 | 72,557 | 1,217,497 | 3,655,215 | $207,208,696 | 7,265,140 | $296,557,685 |

| | | | | |
|---|---|---|---|---|
| Foundry pig | 302,154 tons | a $27, | | $8,158,158 |
| Foundry cold-blast charcoal iron for car wheels, &c. | 35,000 " | a 35, | | 1,225,000 |
| Rails | 142,555 " | a 63, | | 8,980,965 |
| Boiler and sheet | 38,639 " | a 120, | | 4,636,680 |
| Nails | 81,462 " | a 84, | | 6,842,808 |
| Bar, rod, hoop, and band | 235,425 " | a 65, | | 15,302,625 |
| Hammered iron | 21,000 " | a 125, | | 2,625,000 |
| Total | | | | $47,771,236 |

Mr. Smith presents the following conclusion to the "Statistical Report of the Iron Manufacture:" "The great facts demonstrated are, that we have nearly 1,200 efficient works in the Union; that these produce annually about 850,000 tons of iron, the value of which in an ordinary year is $50,000,000; of this amount the portion expended for labor alone is about $35,000,000."

The following table gives the different kinds of pig metal and the total amount produced in each year since 1856:

| YEAR. | Tons Anthracite Pig Iron. | Tons raw Bituminous Coal and Coke Pig Iron. | Tons Charcoal Pig Iron. | Total. |
|---|---|---|---|---|
| 1857, | 390,385 | 77,451 | 330,321 | 798,157 |
| 1858, | 361,430 | 58,351 | 285,313 | 705,095 |
| 1859, | 471,745 | 84,841 | 284,041 | 840,627 |
| 1860, | 519,211 | 122,228 | 278,331 | 919,770 |
| 1861, | 409,229 | 127,037 | 195,278 | 731,544 |
| 1862, | 470,315 | 130,687 | 186,660 | 787,662 |
| 1863, | 577,638 | 157,961 | 212,005 | 947,604 |
| 1864, | 684,018 | 209,626 | 241,853 | 1,135,497 |
| 1865, | 479,588 | 189,682 | 262,342 | 831,282 |
| 1866, | 749,367 | 286,996 | 332,280 | 1,350,943 |
| 1867, | 798,638 | 318,647 | 344,341 | 1,461,626 |
| 1868, | 893,000 | 340,000 | 370,000 | 1,603,000 |
| 1869, | 971,150 | 553,341 | 392,150 | 1,916,641 |
| 1870, | 940,500 | 550,000 | 360,000 | 1,850,000 |
| 1871, | 875,999 | 650,000 | 375,000 | 1,900,000 |

The manufacture of iron rails has existed for nearly twenty-five years in the United States, but has only assumed any great magnitude since 1854. The annual production of American rails since 1861 has been: 1861, 189,818 tons; 1862, 213,912; 1863, 275,768; 1864, 335,369; 1865, 356,292; 1866, 430,778; 1867, 462,108; 1868, 506,714; 1869, 593,586; 1870, 620,000; 1871, 722,000 tons. In the last named year, 572,386 tons were imported from Great Britain.

The census of 1860 gives the following statistics of the iron production and manufacture of that year. There had been very little progress in the production of iron in the country for several years previous, in consequence of the very low rate of duty at which foreign railroad and other iron was admitted.

| | |
|---|---|
| Iron blooms, valued at | $2,623,178 |
| Pig iron | 20,870,120 |
| Bar, sheet and railroad iron | 31,888,705 |
| Iron wire | 1,643,857 |
| Iron forgings | 1,907,460 |
| Car wheels | 2,083,350 |
| Iron castings of all kinds | 36,132,033 |
| | $97,148,705 |

The opening of the war, in 1861, gave an extraordinary impetus to iron production and manufacture. The tariff and other causes reduced the importation to a minimum, while the demand for iron for the fabrication of small arms and cannon; for the construction of the large fleet of iron-clads, and for the other war vessels; for the building of locomotives, the casting of car wheels and furnishing the vast quantity of railroad iron needed to repair the old tracks destroyed by the contending armies, and to lay the tracks of new roads, extended the business vastly beyond all former precedent; and the requirement that the Pacific railroad and its branches shall be constructed solely of American iron, as well as the increase in its use for buildings, and for shipping, have maintained it in a prosperous condition.

The manufacture of steel and the other manufactures of iron, aside from those already enumerated, brought the aggregate production and manufacture of iron and steel, in 1860, up to $285,879,510. The revenue tax paid on iron and steel manufactures in 1864 indicates that the product of the branches taxed amounted to about $123,000,000. This estimate was far below the production, as many branches were not taxed, and the returns of that year were imperfect. The production and manufacture of 1865 were not less than 400 millions of dollars.

There is every reason to expect that the development of the iron mines will be pushed forward with constantly increasing energy, and that the time is not far distant when many of the great repositories of ores we have described—now almost untouched—will be the seats of an active industry and centres of a thriving population, supported by the home markets they will create. The great valley of the west, when it becomes intersected in every direction with the vast system of railroads, of which the present lines form but little more than outlines, will itself require more iron than the world now produces, and the transportation of large portions of this from the great iron regions of northern Michigan, Wisconsin, Oregon, and Utah, and of coal back to the mines, will sustain larger lines of transportation than have ever yet been employed in conveying to their markets the most important products of the country. The importation of foreign iron—already falling off in proportion to the increased consumption—must, before many years, almost cease, and be succeeded by exports for the supplies of other nations less bountifully provided for than the United States and Great Britain.

## CHAPTER II.

### COPPER.

THE early attempts to work copper mines in the United States have already been alluded to in the introductory remarks to the department of this work relating to mining industry. The ores of this metal are widely distributed throughout the country, and in almost every one of the states have been found in quantities that encouraged their exploration—in the great majority of cases to the loss of those interested. The metal is met with in all the New England states, but only those localities need be named which have at times been looked upon as important.

Copper occurs in a native or metallic state, and also in a variety of ores, or combinations of the metal with other substances. In these forms the metallic appearance is lost, and the metal is obtained by different metallurgical operations, an account of some of which will be presented in the course of this chapter. Until the discovery of the Lake Superior mines, native copper, from its scarcity, was regarded rather as a curiosity than as an important source of supply. The workable ores were chiefly pyritous copper, vitreous copper, variegated copper, the red oxide, the green carbonate or malachite, and chrysocolla. The first named, though containing the least proportion of copper, has furnished more of the metal than all the other ores together, and is the chief dependence of most of the mines. It is a double sulphuret of copper and iron, of bright yellow color, and consists, when pure, of about 34 per cent. of copper, 35 of sulphur, and 30 of iron. But the ore is always intermixed with quartz or other earthy minerals, by which its richness is greatly reduced. As brought out from the mine it may not contain more than 1 per cent. of copper, and when freed as far as practicable from foreign substances by the mechanical processes of assorting, crushing, washing, jigging, etc., and brought up to a percentage of 6 or 7 of copper, it is in Cornwall a merchantable ore, and the mine producing in large quantity the poor material from which it is obtained may be a profitable one. Vitreous copper, known also as copper glance, and sulphuret of copper, is a lead gray ore, very soft, and contains 79.8 per cent. of copper, united with 20.2 per cent. of sulphur. It is not often found in large quantity. Variegated or purple copper is distinguished by its various shades of color and brittle texture. It yields, when pure, from 56 to 63 per cent. of copper, 21 to 28 of sulphur, and 7 to 14 of iron. The red oxide is a beautiful ore of ruby red color, and consists of 88.8 per cent. of copper and 11.2 per cent. of oxygen. It is rarely found in sufficient quantity to add much to the products of the mines. Green malachite is a highly ornamental stone, of richly variegated shades of green, famous as the material of costly vases, tables, etc., manufactured in Siberia for the Russian government. It is always met with in copper mines, especially near the surface, but rarely in large or handsome masses. It consists of copper 57.5, oxygen 14.4, carbonic acid 19.9, and water 8.2 per cent. Chrysocolla is a combination of oxide of copper and silica, of greenish shades, and is met with as an incrustation upon other copper ores. It often closely resembles the malachite in appearance. It contains about 36 per cent. of copper.

The first mines worked in the United States were peculiar for the rich character of their ores. These were, in great part, vitreous and variegated copper, with some malachite, and were found in beds, strings, and bunches in the red sandstone formation, especially along its line of contact with the gneiss and granitic rocks in Connecticut, and with the trap rocks in New Jersey. The mine at Simsbury, in Connecticut, furnished a considerable amount of such ores from the year 1709 till it was purchased, about the middle of the last century, by the state, from which time it was occupied for sixty years as a prison, and worked by the convicts; not, however, to much profit. In 1830 it came into possession of a company, but was only worked for a short time afterward. On the same geological range, but lying chiefly in the gneiss rocks, the most productive of these mines was opened in

1836, in Bristol, Conn. It was vigorously worked from 1847 to 1857, and produced larger amounts of rich vitreous and pyritous ores than have been obtained from any other mine in the United States. No expense was spared in prosecuting the mining, and in furnishing efficient machinery for dressing the ores. Although 1,800 tons of ore, producing over $200,000, were sent to market, the ore yielding from 18 to 50 per cent. of copper, the mine proved a losing affair, and was finally abandoned in 1857. Recently there have been mines of copper developed in Maine, some of them of considerable promise, others not as yet productive, though they have invested considerable sums in machinery, dead work, wages, and material. Three of the mines in Hancock county, Maine, are doing moderately well. They have been in operation about five years; the first two or three of which were spent in obtaining their capital, establishing their plant and reduction works and getting fairly at work. They had, in 1880, a capital of $104,000, of which the plant had cost $71,500, the real estate or mining lands, $28,000, and the working capital $4,500. They had raised that year 12,500 tons of ore, from which they had made 83,080 pounds of ingot copper, worth $10,125, using $9,767 worth of material and paying $36,500 wages. They were so situated as to have the capacity to produce 672,000 pounds of ingot copper, and the ore, though not very rich. was plentiful, easily worked and readily shipped, so that there was a fair prospect for a moderately paying business. In one and perhaps more of these mines there is a small percentage of silver with the copper. The New Hampshire mines (pyritous ores) had not, in 1880, produced any pure copper.

The New Jersey mines have all failed from insufficient supply of the ores. The Schuyler mine, at Belleville, produced rich vitreous copper and chrysocolla, disseminated through a stratum of light brown sandstone, of 20 to 30 feet in thickness, and dipping at an angle of 12°. During the last century, the excavations reached the depth of 200 feet, and were extensively tunnelled. The mine was then so highly valued that an offer of £500,000, made for it by an English company, was refused by the proprietor, Mr. Schuyler. In 1857–58 attempts were made to work the mine again, but soon failed. Among the other mines which have been worked to considerable extent in New Jersey are the Flemington mine, and the Bridgewater mine, near Somerville, at which native copper in some quantity was found in the last century; two pieces met with in 1754 weighing together, it was reported, 1,900 lbs. A mine near New Brunswick also furnished many lumps of native copper, and thin sheets of the metal were found included in the sandstone. At different times this mine has been thoroughly explored, but always with a loss. In Somerset county, the Franklin mine, near Griggstown, has been worked to the depth of 100 feet. One mine is now (1881) operated in Montgomery County, Penn.. which yielded in 1880 40,460 lbs of copper, worth $5,630, and at a net cost for mining of less than $2,000. The amount of capital invested is only $8,500.

Another copper district, which at first promised fairly, is in Maryland, near Sykesville, Carroll county, on the Baltimore and Ohio railroad, thirty-two miles from Baltimore, in a region of micaceous, talcose, and chlorite slates. This mine first opened about 1850, in 1856–7 produced 300 tons of ore, valued at $17,897, the ore yielding, according to the estimates of the metallurgists, 16.03 per cent. of ingot copper. It has been worked moderately to the present time, but its production has fallen off, the ore raised in 1880 being only eighty-two tons. There is some error in the census report of the mine, which renders it impossible to say what the actual percentage of ingot copper in the ore now is; but it is evident that the business is not profitable. The other copper mines in Maryland have not, in 1880, produced any ingot copper.

Like the last named, all the other localities of copper ores of any importance along the Appalachian chain and east of it are remote from the range of the red sandstone, and belong to older rock formations. In Vermont, mining operations were carried on for several years upon a large lode of pyritous copper, which was traced several miles through Vershire and Corinth. At Strafford, pyritous ores were worked in 1829 and afterward, both for copperas and copper. One of these is still worked, and is the best single copper mine east of the Alleghanies. It yielded in 1880, 2,647,894 pounds of ingot copper, valued at $469,495, the expense of production (material and wages) being $367,760, or a net profit of about $102,000. Pyritous ores yielding 24.3 per cent. of copper were found in Ulster Co., N. Y., in 1853, but did not hold out and the mine was abandoned.

In Virginia, rich ores of red oxide of copper, associated with native copper and pyritous copper, have been found at Manassas Gap, and also in many other places further south along the Blue Ridge. The ores at these and other points were very promising and yielded at first very considerable amounts (those in Carroll, Floyd and Grayson Counties sending to market between 1855 and 1860 about 10,000,000 lbs. of ores); but there was no appearance of any regular veins, and the supply soon gave out. In the gold mines of Virginia and North Carolina copper is often combined with the gold, and parted from it and sent to market, but there are no mines for copper alone in that region, except two in Ashe county, North Carolina, which yielded in 1880, 1,640,000 pounds of copper worth $350,000, at a net cost of $194,631 (material and wages). These mines have a large capital, and employ about 328 men, but they are doing better than any other mines east of the Alleghanies.

In Tennessee copper mining has passed through many vicissitudes. In 1847 the ores were first discovered in Polk county and traced to Gilmer county, Georgia, associated with masses of hematite iron ores. Mining was commenced in 1851, and in the next seven years fourteen mining companies were formed and copper mining was carried on upon a large scale. The ores yielded from 15 to 45 per cent. of copper and the product of 1856–7 was estimated at $1,836,000; there were several German smelting furnaces, producing regulus or concentrated copper ore in large quantities, four reverberatory, two blast and two calcining furnaces. In 1857 these mines, now numbering seventeen or eighteen, were consolidated into three companies, with large capital, producing monthly about 1,600 tons of ore, or nearly 20,000 tons a year, ranging from 12 to 15 per cent. in value, and with furnaces and smelting works of all kinds to reduce the ores. Railroad connections had been formed with the mines and there were prospects of a profitable and enduring mining interest. But the financial disasters of 1857 were followed by the war, and the mines were abandoned. After the war some feeble efforts were made to revive them, but the richer mines of Lake Superior supplied the market and not much could be done. In 1880 one mine was operated out of the whole number in Polk Co., and raised 294 tons of ore at an expense of $1,200 for wages. The value of the product is not given—it may not have been smelted in Polk Co., but it could hardly have been sufficient to make the business profitable. The capital invested is reported at $140. There are also some small mines at Ducktown, Tenn., the product of ore in 1880 being 70 tons, but no report of the value of product being given.

Of the other States east of the Missouri River, aside from Michigan, only two, Missouri and Wisconsin, have copper mines in operation. At one time there were some small but unprofitable mines in Iowa, but these have been abandoned long since. The Wisconsin mine now in operation is in Iowa Co., in the lead district. It is a small mine, yielding in 1880 only 62 tons of ore, but the ore is rich, the investment small, and the mine pays better than some larger ones. The geologists report that the copper deposits of the Lake Superior region in Michigan extend to the northeast counties of Minnesota and Wisconsin, but so far as we know there have as yet been no explorations for copper veins there.

Missouri has a copper district small in extent, in St. Genevieve Co., in the vicinity of the lead and iron deposits in that State. There are three mines now in operation, of large capacity, but they yielded in all in 1880 but 1,051 tons of ore, from which was extracted 230,717 pounds of ingot copper, worth $25,730, of which somewhat more than one-third was net profit. The capital is not large, only $15,480 for the three, but these are among the few copper mines away from Lake Superior that pay.

Of the extreme western states and territories four only (Colorado, Arizona, Idaho and California) are now known to produce copper. It is very probable that Utah, New Mexico, and possibly Montana, Dakota (in the Black Hills country) and Washington Territory, may be added to the number.

In Colorado there are very few if any copper mines proper, but both the gold and silver are combined with copper and often to such an extent as to make the saving of the copper in the reduction of the ores profitable. Arizona and California, and, it is probable, Idaho also, have deposits of pure copper ores, as well as these combinations with silver and gold; and most of the ores are rich enough to pay well if a market is easily reached.

The census of 1880 has not yet given us in detail the statistics of copper mining in these states and territories. Their aggregate production in that year is stated at 6,244,702 pounds, worth $1,248,940.

But the most remarkable deposits of copper in the United States, and perhaps in the world, are those of the Lake Superior region in Northern Michigan.

The existence of native copper on the shores of Lake Superior is noticed in the reports of the Jesuit missionaries of 1659 and 1666. Pieces of the metal ten to twenty pounds in weight were seen, which it is said the Indians reverenced as sacred; similar reports were brought by Father Dablou in 1670, and by Charlevoix in 1744. An attempt was made in 1771 by an Englishman named Alexander Henry to open a mine near the forks of the Ontonagon, on the bank of the river, where a large mass of the metal lay exposed. He had visited the region in 1763, and returned with a party prepared for more thoroughly exploring its resources. They, however, found no more copper besides the loose mass, which they were unable to remove. They then went over to the north shore of the lake, but met with no better success there. General Cass and Mr. H. R. Schoolcraft visited the region in 1819, and reported on the great mass upon the Ontonagon. Major Long, also, in 1823, bore witness to the occurrence of the metal along the shores of the lake. The country, till the ratification of the treaty with the Chippewa Indians, in 1842, was scarcely ever visited except by hunters and fur-traders, and was only accessible by a tedious voyage in canoes from Mackinaw. Dr. Douglass Houghton, the state geologist of Michigan, made the first scientific examination of the country in 1841, and his reports first drew public attention to its great resources in copper. His explorations were continued both under the state and general government until they were suddenly terminated with his life by the unfortunate swamping of his boat in the lake, near Eagle river, October 13, 1845.

In 1844 adventurers from the eastern states began to pour into the country, and mining operations were commenced at various places near the shore, on Keweenaw Point. The companies took possession under permits from the general land office, in anticipation of the regular surveys, when the tracts could be properly designated for sale. Nearly one thousand tracts, of one mile square each, were selected—the greater part of them at random, and afterward explored and abandoned. In 1846 a geological survey of the region was authorized by Congress, which was commenced under Dr. C. T. Jackson, and completed by Messrs. Foster and Whitney in 1850. At this time many mines were in full operation, and titles to them had been acquired at the government sales.

The copper region, as indicated by Dr. Houghton, was found to be nearly limited to the range of trap hills, which are traced from the termination of Keweenaw Point toward the south-west in a belt of not more than two miles in width, gradually receding from the lake shore. The upper portion of the hills is of trap rock, lying in beds which dip toward the lake, and pass in this direction under others of sandstone, the outcrop of which is along the northern flanks of the hills. Isle Royale, near the north shore of the lake, is made up of similar formations, which dip toward the south. These rocks thus appear to form the basin in which the portion of Lake Superior lying between is held. The trap hills are traced from Keweenaw Point in two or three parallel ridges of 500 to 1,000 feet elevation, crossing Portage lake not far from the shore of Lake Superior, and the Ontonagon river about 13 miles from its mouth. They thence reach further back into the country beyond Agogebic lake, full 120 miles from the north-eastern termination. Another group of trap hills, known as the Porcupine mountains, comes out to the lake shore some 20 miles above the mouth of the Ontonagon, and this also contains veins of copper, which had been little developed until the explorations commenced near Carp lake in these mountains in 1859. These resulted in a shipment of over 20 tons of rough copper in 1860. The formations upon Isle Royale, which is within the boundary of the United States, although they are similar to those of the south shore, and contain copper veins upon which explorations were vigorously prosecuted, have not proved so valuable as they promised, and only three small mines are now worked there. The most productive mines are comprised in three districts along the main range of the trap hills. The first is on Keweenaw Point, the second about Portage lake, and the third near the Ontonagon river. All the veins are remarkable for producing native copper alone, the only ores of the metal being chiefly of vitreous copper found in a range of hills on the south side of Keweenaw Point, and nowhere in quantities to justify the continuation of mining operations that were commenced upon them. The veins on Keweenaw Point cross the ridges nearly at right angles, penetrating almost vertically through the trap and the sandstones. Their productiveness is, for the most part, limited to certain amygdaloidal belts of the trap, which alternate with other unproductive beds of gray compact trap, and the mining explorations follow the former down their slope of 40°, more or less, toward the north. The thickness of the veins is very variable, and also their richness, even in the amygdaloid. The copper is found interspersed in pieces of all sizes through the quartz vein stones and among the calcareous spar, laumonite, prehnite, and other minerals associated with the quartz. These being extracted, piles are made of the poorer sorts, in which the metal is not sufficiently clear of stone for shipment, and these are roasted by firing the wood intermixed through the heaps. By this process the stone entangled among the copper is more readily broken and removed. The lumps that will go into barrels are called "barrel work," and are packed in this way for shipment. Larger ones, called "masses," some of which are huge, irregular-shaped blocks of clean copper, are cut into pieces that can be conveniently transported, as of one to three tons weight each. This is done by means of a long chisel with a bit three-fourths of an inch wide, which is held by one man and struck in turns by two others with a hammer weighing 7 or 8 lbs. A groove is thus cut across the narrowest part of the mass, turning out long chips of copper one-fourth of an inch thick, and with each succeeding cut the groove is deepened to the same extent until it reaches through the mass. The process is slow and tedious, a single cut sometimes occupying the continual labor of three men for as many weeks, or even longer. This work is done in great part before the masses can be got out of the mine. The masses are found in working the vein, often occupying the whole space between the walls of trap rock, standing upon their edges, and shut in as solidly as if all were one material. To remove one of the very large masses is a work of many months. It is first laid bare along one side by extending the level or drift of the mine through the trap rock. The excavation is carried high enough to expose its upper edge and down to its lower line; but on account of irregular shape and projecting arms of copper, which often stretch forward, and up and down, connecting with other masses, it requires long and tedious mining operations to determine its dimensions. When it is supposed to be nearly freed along one side, very heavy charges of powder are introduced in the rock behind the mass, with the view of starting it from its bed. When cracks are produced by these, heavier charges are introduced in the form of sand-blasts, and these are repeated until the mass is thrown partly over on its side as well as the space excavated will admit. In speaking further of the Minesota mine, the enormous sizes of some of the masses, and the amount of powder consumed in loosening them, will be more particularly noticed.

To separate the finer particles of copper from the stones in which they are contained, these, after being roasted, are crushed under heavy stamps to the condition of fine sand, and this is then washed after the usual method of washing fine ores, until the earthy matters are removed and the metallic particles are left behind. This is shovelled into small casks for shipment, and is known as stamp copper. The stamping and crushing machinery, such as have long been used at the mining establishments of other countries, were found to be entirely too slow for the requirements of these mines, and they have been replaced by new apparatus of American contrivance, which is far more efficient than any thing of the kind ever before applied to such operations. The stamps heretofore in use have been of 100 lbs. to 300 lbs. weight, and at the California mines were first introduced of 800 lbs. to 1,000 lbs. weight. At Lake Superior they are in use on the plan of the steam hammer, weighing, with the rod or stamp-leg, 2,500 lbs. and making 90 to 100 strokes in a minute. The capacity of each stamp is to crush over one ton of hard trap rock every hour. It falls upon a large mortar that rests upon springs of vulcanized rubber, and the force of its fall is increased by the pressure of steam applied above the piston to throw it more suddenly down. The stamp-head covers about one-fourth of the face of the mortar, and with every succeeding stroke it moves to the adjoining quarter, covering the whole face in four strokes.

The only other metal found with the copper is silver, and this does not occur as an alloy, but the two are as if welded together, and neither, when assayed, gives more than a trace of the other. It is evident from this that they cannot have been in a fused state in contact. The quantity of silver is small; the largest piece ever found weighing a little more than 8 lbs. troy. This was met with at the mines near the mouth of Eagle river, where a considerable number of loose pieces, together with loose masses of copper, were obtained in exploring deep under the bed of the stream an ancient deposit of rounded boulders of sandstone and trap. The veins of even the trap rocks themselves of this locality exhibited so much silver that in the early operations of the mines a very high alue was set upon them on this account.

The principal mine of this district is the Cliff mine of the Pittsburgh and Boston Company, opened in 1845, and steadily worked ever since. In 1858, the extent of the horizontal workings on the vein had amounted to 12,368 feet, besides 831 feet in cross-cuts. Five shafts had been sunk, one of which was 817 feet deep, 587 feet being below the adit level, and 230 feet being from this level to the summit of the ridge. The shaft of least depth was sunk 422 feet.

The production of the mine from the year 1853 is exhibited in the following table:—

| Yr. | Minerals produced. | Refined copper, lbs. | Yield per cent. | Price per lb. deducting cost of smelting. | Value realized. |
|---|---|---|---|---|---|
| 1853, | 2,263,182 | 1,071,288 | 47.33 | Cts. 27 32 | $292,647.05 |
| 1854, | 2,332,614 | 1,315,308 | 56.35 | 24.38 | 320,783.01 |
| 1855, | 2,995.837 | 1,874,197 | 62.56 | 25.33 | 475,911.26 |
| 1856, | 3,291.239 | 2,220.934 | 67 48 | 24.12 | 535.843.67 |
| 1857, | 3,363,557 | 2,363.850 | 70.28 | 20.44 | 497,870.47 |
| 1858, | 3,183,685 | 2,331.964 | 71 00 | 21.03 | 475.321.89 |
| 1859, | 2,139.632 | 1 415.007 | 64.35 | 20 50 | 290,097.97 |
| 1860, | 2,805,442 | 1,843.313 | | 22.87 | 421,565.67 |
| 1861, | | 1,928,011 | | 27.44 | |
| 1862, | | 2,004.060 | | 26.75 | |
| 1863, | | 2,100,354 | | 34.00 | |
| 1864, | | 1.351.334 | | 47.00 | |
| 1865, | | 1,494.626 | | 39.25 | |
| 1866, | | 1,642,928 | | 34 25 | |
| 1867, | | 1,121.725 | | 25 37 | |
| 1868, | | 1,227.746 | | 23.12 | |
| 1869, | | 1,905,314 | | 24.25 | |
| 1870, | | 809,571 | | 20.88 | |
| 1871, | | 142.238 | | 24.25 | |
| 1872. | | 118.386 | | 36.12 | |
| 1873, | | 751.203 | | 27.50 | |
| 1874, | | 1.052,901 | | 22.00 | |
| 1875, | | 1,162.883 | | 22.50 | |
| 1876, | | 900.146 | | 21.00 | |
| 1877, | | 161,319 | | 19.25 | |
| 1878, | | 414,415 | | 16.62 | |
| Tot'l | | 37,245,226 | Av. | Av. 25.87 | $9,635,339 97 |

The Portage lake mining district is some twenty to twenty-five miles west from the

Cliff mine on the same range of hills. This region is of more recent development, the explorations having been attended with little success previous to 1854. The veins are here found productive in a gray variety of trap as well as the amygdaloidal, and instead of lying across the ridges, follow the same course with them, and dip in general with the slope of the strata. Some of the larger veins consist in great part of epidote, and the copper in these is much less dense than in the quartz veins, forming tangled masses which are rarely of any considerable size. On the eastern side of this lake are worked, among other mines, the Quincy, Pewabic, and Franklin, and on the opposite side the Isle Royale, Portage, and Columbia mines.

The Quincy, Pewabic, and Franklin commenced operations from 1855 to 1857, and by 1860 were doing a fine business. There were some masses of native copper taken from each mine and considerable barrel work, but two thirds of the whole was from the small quantity of copper in the amygdaloid belt or veinstone, which was passed through the stamps (each mine having a first-class stamp-mill). Farther on we shall give a full description of this process of mining and stamping, which is used on all the quartz veins and lodes in the gold districts, as well as in copper mining. At first the Pewabic mine took the lead, reaching in 1861 a production of 958¾ tons of copper, but this was its highest production; the Quincy in 1860, the first year that it reported, produced 970¼ tons; in 1861, 1,282½ tons, and has ranged from 1,100 to 1,536 tons almost every year since, while the Pewabic has ranged from 147 tons to 920, the later years averaging not over 280 tons annually since 1870. The Franklin beginning much smaller has ranged from 183 to 1,178 tons, yielding more than the Pewabic and about half as much as the Quincy. To 1st January, 1878, the Franklin mine had produced 11,500 tons, 914 lbs. of copper; the Pewabic 10,643 tons, 1,314 lbs.; the Quincy 23,175 tons, 675 lbs. or more than both the others. This last company, whose stockholders had never expended more than $200,000 upon it, had divided among them $2,130,000 and had a surplus of $464,000. It had received from the sales of copper, etc., $11,127,109.12. The Pewabic with a capital of $240,000 had paid $400,000 dividend. The Franklin with $380,000 capital had paid $240,000 dividends.

The Ontonagon river crosses the trap hills about forty miles southwest from Portage lake, and the mines worked in the Ontonagon district are scattered along the hills northeast from the river for a distance of nearly twenty miles. The outlet for a greater number of them is by a road through the woods to the village at the mouth of the river. The veins of this district also lie along the course of the ridges, and dip with the trap rocks toward the lake. As they are worked, however, they are found occasionally to cut across the strata, and neighboring veins to run into each other. In some places copper occurs in masses scattered through the trap rock with no sign of a vein, not even a seam or crevice connecting one mass with another. They appear, however, to be ranged on the general course of the strata. At the Adventure mine they were so abundant, that it has been found profitable to collect them, and the clifts of the trap rock present a curious appearance, studded over with numerous dark cavities in apparently inaccessible places leading into the solid face of the mountain.

The great mine of this district from 1855–1869 was the Minnesota, two miles east from the Ontonagon river. The explorers in this region in the winter of 1847–48, found parallel lines of trenches, extending along the trap hills, evidently made by a man at some distant period. They were so well marked, as to be noticed even under a cover of three feet depth of snow. On examination they proved to be on the course of veins of copper, and the excavations were found to extend down into the solid rock, portions of which were sometimes left standing over the workings. When these pits were afterwards explored, there were found in them large quantities of rude hammers, made of the hardest kind of greenstone, from the trap rocks of the neighborhood. These were of all sizes, ranging from four to forty pounds weight, and of the same general shape—one end being rounded off for the end of the hammer, and the other shaped like a wedge. Around the middle was a groove—the large hammers had two — evidently intended for securing the handle by which they were wielded. In every instance the hammers were more or less broken, evidently in service. One of them brought from the mine by the writer, and now in the collection of the Cooper Union of New York, is represented in the accompanying sketch. It measures 6½ inches in length, the same in breadth, and 2½ inches in thickness.

The quantity of hammers found in these old workings was so great that they were collected by cart-loads. How they could have been made with such tools as the ancient miners had, is unaccountable, for the stone itself is the hardest material they could find. And it is not any more clear, how they applied such clumsy tools to excavating solid rock nearly as hard as the hammers themselves. Every hammer is broken on the edge, as if worn out in service. The only tools found besides these were a copper gad or wedge, a copper chisel with a socket head, and a wooden bowl. The great extent of the ancient mining operations indicates that the country must have been long occupied by an industrious people, possessed of more mechanical skill than the present race of Indians. They must also have spread over the whole of the copper region, for similar evidences of their occupancy are found about all the copper mines, and even upon Isle Royale. It is not improbable that they belonged to the race of the mound builders of the western states, among the vestiges of whom, found in the mounds, various utensils of copper have been met with. But of the period when they lived, the copper mines afford no more evidence than the mounds. Some of the trenches at the Minesota mine, originally excavated to the depth of more than twenty-five feet, have since filled up with gravel and rubbish to within a few feet of the surface, a work which in this region would seem to require centuries; and upon the surface of this material large trees are now standing, and stumps of much older ones are seen, that have long been rotting. In clearing out the pits a mass of copper was discovered, buried in the gravel nearly twenty feet below the surface, which the ancients had entirely separated from the vein. They had supported it upon blocks of wood, and, probably by means of fire and their hammers, had removed from it all the adhering stone and projecting points of copper. Under it were quantities of ashes and charred wood. The weight of the mass, after all their attempts to reduce it, appears to have been too great for them to raise; and when it was finally taken out in 1848, it was found to weigh over six tons. It was about ten feet long, three feet wide, and nearly two feet thick. Beneath this spot the vein afterward proved extremely rich, affording many masses of great size.

The veins worked by the Minesota Company all lie along the southern slope of the northern trap ridge, not far below the summit. Three veins have been discovered which lie nearly parallel to each other. The lowest one is along the contact of the gray trap of the upper part of the hill and a stratum of conglomerate which underlies this. It dips with the slope of this rock toward the north-north-west at an angle of about 46° with the horizon. The next upper vein outcropping, 80 or 90 feet further up the hill, dips about 61°, and falls into the lower vein along a very irregular line. Both veins are worked, and the greatest yield of the mine has been near their line of meeting.

The position of the veins along the range of the rocks, instead of across them, gives to the mines of this character a great advantage, as their productiveness is not limited to the thickness of any one belt which proves favorable for the occurrence of the metal; and the outcrop of the vein can be traced a great distance along the surface, affording convenient opportunities for sinking directly upon it at any point.

The Minnesota Company, having abundant room, were soon able to sink a large number of shafts along a line of outcrop of 1,800 feet, and several of the levels below extended considerably further than this entire length. In 1858 nine shafts were in operation, and ten levels were driven on the vein, the deepest at 536 feet down the slope. The ten fathom level at that time was 1,960 feet in length. This mine has been remarkable for the large size and great number of its masses. The largest one of these, taken out during the year 1857, after being uncovered along its side, refused to give way, though 1,450 pounds of powder had been exploded behind it in five successive sand-blasts. A charge of 625 pounds being then fired beneath it, the mass was so much loosened that by a succeeding blast of 750 pounds it was torn off from the masses with which it connected, and thrown over in one immense piece. It measured forty-five feet in length, and its greatest thickness was over eight feet. Its weight was estimated at about 500 tons. What it proved to be is not certain, as no account was preserved of the pieces into which it was cut, but it is known to have exceeded 400 tons. Other masses have been taken out which presented a thickness of over five feet solid copper. The value of the silver picked out from among the copper has amounted in one year to about $1,000.

This mine was the first in which large masses of copper were found. It is peculiar in its character, being not a true vein, but a lode running with the formation, and carrying as its chief burden masses of copper of great purity and several hundred tons in weight. From 1848 to 1869 it yielded a vast amount of copper (1,976 tons in 1857 and 1,901 in 1858, but in 1865 it began to fall off, and diminished every year till in 1876 it yielded only 44½ tons, and its managers withdrew from it and it went into the hands of tributors. It had paid its stockholders over two million dollars in dividends, and had, in 1878, produced 17,263½ tons of copper. Besides the dividends named, the original stockholders have derived large profits from the sale of portions of the extensive territory, three miles square, which belonged to the company, and the organization upon these tracts of new companies.

We have yet one more of these mines to describe, and this probably the most productive copper mine in the world for the time it has been operated. We give it also as an example of a class of mines not elsewhere known, the ores being found not in veins or lodes, but in belts of conglomerate.

*The Calumet and Hecla Mine*, situated in Houghton county, about ten miles from Hancock on the old Eagle River trail, was first discovered in 1866, in the following manner: A half-way house, a rude cabin, or in western phrase a "*shebang*," was kept by a man who dealt out whiskey, and had for his only constant companions, some barnyard fowls and two pigs, which he strove to keep in a pen. Not liking the confinement, the pigs as often as possible rooted their way out and wandered into the adjacent roads. Their owner tried, often in vain, to lure them back to the pen. One hot day after an ineffectual chase, he came in swearing like a pirate, and begged a French gentleman, who was resting in the cabin, to shoot them. The gentleman did as he desired, and shot and wounded one of them. The pig ran away squealing, and tracking it by its blood the owner found it hidden in a nest on the side of a knoll. He noticed, where the pigs had rooted, green carbonate of copper plentifully mixed with the earth, and digging into the knoll found further evidences of copper. He communicated the discovery to Mr. John Hulbert, who was exploring there at the time, and he in turn to Mr. Edward J. Hulbert. The mound was examined, a pit sunk some 15 feet through the sand, and they came upon the great Calumet Conglomerate. This mound had been evidently the work of "the ancient miners."

A company or rather two companies were formed, but soon after consolidated into one, the Calumet and Hecla, with a capital of $2,000,000 in 80,000 shares. Of this only $800,000 was called in; but mining was commenced on a large scale at once, and proved profitable "from the grass roots down," as the western miners say. In 1867 it yielded 675½ tons, though its proprietors were ridiculed for their folly in supposing that a conglomerate could ever yield any considerable quantity of copper. In 1868 it produced 2,549¼ tons, more than any other mine in the Lake Superior region had ever yielded; in 1869 6,157¾ tons; it continued to increase nearly 1,000 tons a year, in 1874 reaching 10,062½ tons; in 1877, 11,284¼ tons, in 1878 12,537½ tons; in 1879, 14,200 tons, and in 1880, over 15,000 tons. Its entire product in the fifteen years of its production is about 140,000 tons of ingot copper. The mineral yields 88 per cent. Its actual capital paid in was $800,000, and it has divided over 16 million dollars among its shareholders to the close of 1881. Its product of copper ingots has realized over $56,000,000. It employs more than 2,000 men, who with their families form a large and important town.

The following description is condensed from an account of the processes employed in the Calumet and Hecla mines:—

"These shafts are sunk to a depth of 75 or 100 feet, at which point the first level is started, and is run from shaft to shaft until the whole number of shafts are connected by a continuous gallery or drift. These drifts are six feet by four, or wider, if necessary to accommodate rail tracks. The shafts, while the drifts are opening, are sunk away to the second level; the second level, in due time, is opened like the first, and so on down. Between the shafts, for the purpose of ventilation and convenience in stoping, minor shafts are sunk, called winzes. The mine thus opened is like the rectangular blocks on a city map tilted up; the shafts and drifts are main streets crossing each other, and the winzes are alleys. The solid blocks of veinstone bounded by the streets are, if the whole lode is workable, taken out, ex cepting pillars of rock left to support the hanging wall and keep the mine from coming together. This work is technically called stoping. The shafts are cribbed from the surface down to solid rock with square timber and plank, and are divided into two or more compartments, in one of which is laid the rail track, in another the pumps, and in the third a ladder-way. But in large mines, like the Calumet, one shaft is used as a pump-shaft, while another shaft, or intermediate opening, is fitted for the man-engine, the duty of which machine is to take the men in and out of the mine. The top of the shaft is carried from twenty to thirty feet above the ground for convenience in the handling of rock. The iron cars or skips, holding several tons, are held by large wire ropes, which pass over pulleys to the drum of the engine. The movement of these skips is regulated with great precision by bell signals, from under ground; and to the brakeman at the drum the position of the skip at any depth, is told by an ingenious little indicator. The skip comes up out of the mine, dumps itself, and returns whence it came. At the Calumet, the skip dumps its load into a car resting on a horizontal tram-road, which car, moved by an endless rope, apparently without human agency, moves off at a considerable speed to the rock-breaking house, perhaps a thousand feet away, where it dumps itself and immediately returns to its proper position. This economical railroad, set on tressels, more or less elevated above the ground, is called Frue's automatic road. The rock from each shaft has the same common destination, the great receiving rock house. Here the large blocks of copper-tied conglomerate are first crushed under a ponderous steam hammer, which resembles a section of the main shaft of an engine; it operates vertically in slides, and has the lower end beveled off. To compare great things with small, it is like the stub of the pencil which the writer is using. The motive power is a steam cylinder on top. Broken by this great hammer, the pieces of rock fall into a number of large and small Blake rock-breakers, whose corrugated iron jaws crunch them up remorselessly. From these breakers the comminuted conglomerate falls into shutes, and thence it is at will drawn into cars. A train of cars, each holding four to eight tons, drawn by a locomotive engine, moves off to the stamp mill, five miles distant, where the copper rock is dumped into large bins placed at the top of the mill. The stamps now begin their work of further reduction; the rock is thrown into the hoppers of the great steam stamp, which strikes a blow of many tons eighty times a minute, smashing the rock into minute pebbles, fine sand, and slime, which is washed from under the head by a stream of water, and carried by the same agent to the washers set on an inclined floor, when by a process of jigging, in fresh supplies of water, the gravel and sand are separated from the freed copper, which, owing to its greater specific gravity, settles at the bottom on the sieves, while the sand is carried over the apron to the waste launder, and is washed out into the lake, or spoil bank. There are a large number of washers in this stamp mill, and the copper rock is subjected to repeated washings, and even the fine slimes are carefully treated upon slime tables, yet quite a percentage of fine copper goes to waste in spite of the most ingenious contrivances used to save it. The mineral, or washed copper, having been graded, is packed into barrels and sent to the smelting works, where, passing through fire, it is purified from all rock remaining and cast into ingots, bolts, bars, and cakes. All of this work—processes which we have not pretended to describe in detail—is accomplished by that potent agent, steam. These stamp mills are an interesting study for any one interested in such works.

"Returning to the mine, we go underground, and fathoms deep, where no ray of sunlight ever pierces, we find a populous community of busy workers; the atmosphere of the place is damp and murky, with a strong odor of sulphur, the remains of exploded powder. The only light is that of tallow candles stuck on the hats of the men with clay, or upon the walls, or as head-lights on the rock cars. Each level is provided with tram roads; the cars are pushed along by men to and from the shafts, where the loaded rock is dumped into the skips. * * * * * The men work ten hours, and are divided into day-shifts and night-shifts, and change from day to night once in seven days. But it frequently happens, in different places, or when greater expedition is required, certain of the miners are divided into three gangs, each gang working eight hours, and all fully occupying the twenty-four hours. Much of the mining is done upon contract, and the average wages are from $45 to $50 per month, out of which the man has to pay his board and other necessary expenses."

Yet profitable as some of these mines have proved, and vast as is the amount of copper shipped from them, it should not be forgotten that of about one hundred and fifty mines, and nearly seventy mining companies, which at various times in the last thirty-five years have been actively and most of them profitably employed, there are now but nineteen mines in the whole Lake Superior district which are actively engaged in mining copper. The total production of these mines from 1847 to Jan., 1881, is about 317,000 tons of ingot copper, worth at the average price $163,952,400. The present production is limited to six mines in Houghton county (of which the Calumet and Hecla is one); four in Keweenaw, one in Isle Royale, and eight in Ontonagon. These mines raised in 1880, 938,960 tons of mineral and produced 45,830,262 pounds of ingot copper; the value was $7,979,232. The number of hands employed was 5,004; the amount of wages paid, $2,461,243, and the value of material consumed, $1,215,206. The amount of capital invested was $30,413,551. In the same year (1880), the whole number of copper mines reported in operation east of the 100th meridian W. long., was thirty-two; the quantity of mineral raised, 1,005,955 tons; the amount of ingot copper produced, 50,655,140 pounds; its value, $8,842,961; the number of hands employed, 6,116; wages paid, $2,915,103; material used, $1,391,101; capital employed, $31,675,096.

### COPPER SMELTING.

The ores of copper, unlike those of most of the other metals, are not in general reduced at the mines; but after being concentrated by mechanical processes called dressing—which consist in assorting the piles according to their qualities, and crushing, jigging, and otherwise washing the poorer sorts—they are sold to smelters, whose establishments may be at great distances off, even on the other side of the globe. The richer ores, worth per ton three or four times as many dollars as the figures that represent their percentage of metal, well repay the cost of transportation, and are conveniently reduced at smelting works situated on the coast near the markets for copper, and where the fuel required for their reduction is cheap. At Swansea, in South Wales, there are eight great smelting establishments, to which all the ores from Cornwall and Devon are carried, and which receive other ores from almost all parts of the world. It is stated that in this district there are nearly 600 furnaces employed, which consume about 500,000 tons of coal per annum, and give employment to about 4,000 persons besides colliers. The amount of copper they supply is more than half of that consumed by all nations. The total product of fine copper produced by all the smelting establishments of Great Britain for 1857 is stated to be 18,238 tons, worth £2,079,323.

The copper smelting works of the United States are those upon the coast, depending chiefly upon foreign supplies of ores, and those of the interior, for melting and refining the Lake Superior copper. There are also the furnaces at the Tennessee mines, which have been already noticed. The former are situated at the following localities: At Point Shirley, in Boston harbor, are the furnaces of the Revere Copper Company, which also has rolling mills and other works connected with the manufacture of copper at Canton, on the Boston and Providence railroad. At Taunton, Mass., a similar establishment to that at Canton is owned by the Messrs. Crocker, of that town. There are smelting furnaces at New Haven, Conn.; at Bergen Point, in New York harbor; and at Baltimore, on a point in the outer harbor. There are in the interior, not only the smelting works connected with some of the large mines in the Lake Superior region, but reduction works at Detroit, Chicago, St. Louis, Omaha, and Golden, Colorado, and so complete is their success that there is no longer any necessity for the exportation of these ores to Swansea or anywhere else for reduction.

The furnaces established for working the Lake Superior copper are at Detroit, Cleveland, and Pittsburg. At the last named are two separate establishments, with each of which is connected a rolling mill, at which the ingot copper is converted into sheets for home consumption and the eastern market. A furnace was also built at Portage lake, Lake Superior, in 1860, of capacity equal to melting 6000 tons of copper annually. The details and extent of the operations carried on by the smelting works appear to have been carefully kept from publication. In a work on "Copper and Copper Smelting," by A. Snowdon Piggott, M. D., who had charge of the chemical assays, etc., for the Baltimore Company, published in 1858, while the English processes are fully described, no information is given as to the methods adopted at the American works; and of their production all the information is contained in the two closing sentences of the appendix, as follows: "Of the copper-smelting establishments of the United States I have no statistics. Baltimore turns out about 8,000,000 pounds of refined copper annually." Applications which have been made by the writer to the proprietors of several of the establishments for information as to the business, have been entirely unsuccessful. The total production of copper in 1880 was supposed to be about 25,328 tons per annum; and of this about 16,000 tons were required by the rolling mills for making sheet copper, sheet brass, and yellow metal.

The French treatise on Metallurgy by Professor Rivot contains the only published description of the American method of smelting copper. By the English process, the separation of the metal from its ores is a long and tedious series of alternate roastings or calcinations, and fusions in reverberatory furnaces. The system is particularly applicable to the treatment of poor, sulphurous ores contaminated with other metals, as iron, arsenic, etc., and can only be conducted to advantage where fuel is very cheap, the consumption of this being at the rate of about 20 tons to the ton of copper obtained. The process employed in Germany is much more simple, and the methods in use at the American smelting works are more upon the plan of these. Blast or cupola furnaces supply at some of them the place of reverberatories, and the separation of the metal is completed in great part by one or two smeltings. The treatment of the Lake Superior copper is comparatively an easy operation. For this large reverberatory furnaces are employed, through the roof of which is an opening large enough to admit masses of 3 to 3½ tons weight, which are raised by cranes and lowered into the furnace. The barrels of barrel work are introduced in the same way, and left in the furnace without unpacking. When the furnace is charged, the opening in the top is securely closed by fire-proof masonry, and the fire of bituminous coal is started, the flame from which plays over the bridge, and, reflected from the roof, strikes upon the copper, causing it gradually to sink down and at last flow in a liquid mass. A small portion of the copper by the oxidizing action of the heated gases is converted into a suboxide, which is partially reduced again, and in part goes into the slags in the condition of a silicate of copper, the metal of which is not entirely recovered. The mixture of quartz, calcareous spar, and epidote accompanying the copper, is sometimes such as to melt and form a good cinder without addition of any other substance, but usually some limestone or other suitable material is added as a flux. Complete fusion is effected in 12 to 15 hours according to the size of the masses, and this is kept up for about an hour in order that the fine particles of copper may find their way through the fluid slag, which floats upon the metal. Working tools called rabbles are then introduced through the side-doors of the furnace, and the charge is stirred up and the slag is drawn out through the door. It falls upon the ground, and is taken when sufficiently cool to the cupola or slag furnaces where it is chilled with water to render it easy to break up. Those portions which contain as much as one fourth per cent. of copper are reserved to be passed through the slag furnace. The total amount of slag is usually less than 20 per cent. of the whole charge. In the melting the copper absorbs carbon, which if allowed to remain would render it brittle and unfit for use. To remove it the fire is so arranged that the gases pass through with much unconsumed air; this playing on the surface of the copper produces a suboxide of the metal, which in the course of half an hour is quite taken up by the copper, and coming in contact with the particles of carbon the oxygen combines with this, and removes it in the form of carbonic acid gas.

It now remains to remove the excess of oxygen introduced, which is effected by the ordinary method of refining. A large proportion of fuel is employed on the grate for the amount of air admitted through it, so that the flames as they pass over the bridge convey little free oxygen, and the surface of the metal is covered with fine charcoal. After a little time a pole of green wood is thrust into the melted copper and stirred about so long as gases escape from the surface. It is then taken out, and if on testing the copper some suboxide still remains, the refining is cautiously continued with charcoal, and just when, as appears by the tests, all the oxide is reduced, the work of dipping out the metal is commenced. This is done by large iron ladles, the whole set of men employed at two furnaces, to the number of about 12, coming to this work and taking turns in the severe task. They protect themselves from the intense heat by wet cloths about their arms, and as quickly as possible bale out a ladle full of copper and empty it into one or more of the ingot moulds, of which 36 are arranged in front of the furnace-door upon three parallel bars over a trough of water. As the metal becomes solid in each mould, this is upset, letting the ingot fall into the water. The weight of the ingot being 20 pounds, the filling of them all removes 720 pounds of copper from the furnace. The metal that remains is then tested, and according to its condition the discharging may be continued or it may be necessary to oxidize the copper again and repeat the refining, or merely to throw more charcoal upon the surface and increase the heat. The time required to ladle out the whole charge is from four to six hours. When this is completed the sole of the furnace is repaired, by stopping the cracks with sand and smoothing the surface to get all ready for the next charge; and at the same time the second furnace has reached the refining stage of the process. One charge to a furnace is made every evening, and as in the night it is necessary only to keep up the fires, the great labor of the process comes wholly in the day time.

The following is the estimated cost at Detroit of the smelting, on a basis of two furnaces, each of which is charged with four and a half to five tons of mass copper, consuming two and a half tons of coal, and producing from three to three and a half tons of ingots :—

| | |
|---|---|
| Labor, 15 hands, at $1.50 | $22.50 |
| Bituminous coal, 5 tons, at $5 | 25.00 |
| Wood and charcoal | 1.25 |
| Repairs to furnace, average for the season.. | 2 00 |
| | $50.75 |

To this should be added, for superintendence, office, and general expenses, perhaps ten dollars more, which would make the cost for six or seven tons of ingot copper, $60.75, or $9 to $10 per ton. At Pittsburg the rate charged has been $11 per ton; and fuel is there afforded at about one third the amount allowed in the above estimate.

The cupola furnaces for treating the slags are of very simple plan and construction. They are of cylindrical form, about ten feet high, and three feet diameter inside. Their walls, the thickness of a single length of fire brick, are incased in boiler-plate iron, and stand upon a cast-iron ring, which is itself supported upon four cast-iron columns about three feet above the ground. Transverse iron bars support a circular plate, and upon this the refractory sand for the sole of the furnace is placed, and well beaten down to the thickness of a foot, with a sharp slope toward the tapping hole. A low chimney conveys away the gaseous products of combustion, and through the base of it the workmen introduce the charges. The blast is introduced by three tuyeres a foot above the sole; but before it enters the furnace it is heated by passing through a channel around the furnace. A steady current is obtained by the use of three double acting blowing cylinders, which give a pressure equal to about three and a half inches of mercury.

The hands employed at the Detroit establishment, besides the superintendent and head smelter, are eighteen furnace men and from five to ten workmen, according to the arrivals of copper during the season of navigation. After the stock thus received is worked up, the furnaces remain idle during the remainder of the winter.

### USEFUL APPLICATIONS OF COPPER.

The uses of copper are so numerous and important that the metal must rank next in value to iron. In ancient times, indeed, it was the more useful metal of the two, being abundant among many nations to whom iron was not known. In the ancient Scandinavian tumuli recently opened in Denmark, among the various implements of stone were found swords, daggers, and knives, the blades of which were, in some instances, of copper, and in some of gold, while the cutting edges were formed of iron, showing that this was more rare and valuable than either copper or gold. It has been supposed that several of the ancient nations, as the Egyptians, Greeks, etc., possessed the art of hardening copper, so as to make it serve the purposes of steel. That they employed it for such uses as those to which we now apply tools of steel is certain, and also that the specimens of some of their copper tools are considerably harder than any we make of the same metal. These are found, on analysis, to contain about one part in ten of tin, which, it is known, increases, when added in small proportions, the hardness of copper, and this was probably still further added to by hammering.

Among the most important uses of the metal at present is that of sheathing the bottoms of ships in order to protect the timbers from the ravages of marine animals, and present a smooth surface for the easy passage of the vessel through the water. The metal is well adapted, from its softness and tenacity, for rolling into sheets, and these were first prepared for this use for the Alarm frigate of the royal navy, in 1761. Sheet lead had been in use before this time, but was soon after given up for copper. On account of the rapid deterioration of the copper by the action of the sea-water, the naval department of the British government applied, in 1823, to the Royal Society for some method of preserving the metal. This was furnished by Sir Humphry Davy, who recommended applying strips of cast iron under the copper sheets, which, by the galvanic current excited, would be corroded instead of the copper. The application answered the purpose intended, but soon had to be given up, for the copper, protected from chemical action, it was found, became covered with barnacles and other shell-fish, so as seriously to impair the sailing qualities of the vessels, and for this reason it has been found necessary to submit to the natural wasting of the metal, and replace the sheets as fast as they become corroded.

Various alloys have been proposed as substitutes for copper. That known as yellow metal, or Muntz's, has been the most successful and has been very generally introduced. It consists of copper alloyed with about 40 per cent. of zinc, and is prepared by plunging cakes of zinc into a bath of melted copper contained in a reverberatory furnace. The volatilization of the zinc and oxidation of the metals is guarded against by a covering of fine charcoal kept upon the melted surface. The bolts, nails, and other fastenings for the sheathing, and for various other parts of the ship, are made also of copper and of yellow metal; and to secure the greatest strength, they should be cast at once in the forms in which they are to be used. The manufacture of all these articles is extensively carried on at the different copper establishments in Massachusetts, Connecticut, and Baltimore.

Sheet copper is also applied to many other very important uses, as for copper boilers and pipes, for large stills and condensers, the vacuum pans of sugar refineries, and a multitude of utensils for domestic purposes, and for employment in the different arts. For engraving upon it is prepared of the purest quality and of different thicknesses, according to the kind of engraving for which it is to be used. The engraver cuts it to the size he requires, planishes it, and gives to it the dead smooth surface peculiar to engraving plates. The smaller utensils of sheet copper, as urns, vases, etc., are very ingeniously hammered out from a flat circular sheet. As the hammering is first applied to the central portion, this spreads and takes the form of a bowl. As the metal becomes harder and brittle by the operation, its softness and ductility are restored by annealing, a process that must often be repeated as the hammering is continued, and toward the last, when the metal has become more susceptible to the change induced by the application of the hammer, the annealing must be very carefully attended to, and the whole process be conducted with much skill and judgment acquired by long experience.

For larger and more common hollow articles, the sheet copper is folded around, and lapped by various sorts of joints, some of which are secured by rivets, and some by a double lap, the two edges locking into each other, and made close by hammering. The edges are also soldered either with soft or hard solder. For the latter an alloy is made for the purpose, by melting in a crucible a quantity of brass, and then stirring in one-half or one-third as much zinc, until the blue flame disappears. The mixture is then turned out into a shallow pan, and when cold the plate is heated nearly red hot, and beaten on an anvil or in a mortar. This is the hard solder of the braziers.

A still more important application of the copper is in the manufacture of the alloy known as brass; and that called bronze also serves many useful purposes. The former is composed of copper and zinc, the latter of copper and tin. It is a curious fact in metallurgy that brass was extensively manufactured, and used more commonly than any single metal or other alloy, many centuries before the existence of such a metal as zinc was known. It was prepared by melting copper and introducing fragments of the *lapis calaminaris*, an ore of zinc, in which the oxide of the metal is combined with carbonic acid. Charcoal was also added to the mixture, and by the reaction with this the zinc ore was reduced to the metallic state, and at once united with the copper, without appearing as a distinct metal. This process is still in use for making brass, but the more common method is to introduce slips of copper into melted zinc, or to plunge beneath melted copper lumps of zinc held in iron tongs. The proportion of the two metals is always uncertain, owing to the unknown quantity of zinc that is consumed and escapes in fumes This is prevented as much as possible by covering the melted metal with fine charcoal, and by throwing in pieces of glass, which melt and cover the mixture with a thin protecting layer. Old brass is much used in making new, and the addition of quantities of this to the pot containingthe other ingredients, adds to the uncertainty of the composition. The best proportion of the two metals is believed to be two parts of copper to one of zinc, which is expressed by the term "eight-ounce brass," meaning eight ounces of zinc to sixteen of copper. Sixteen-ounce brass—the two metals being equal—is a beautiful golden yellow alloy, called prince's metal. But all brass of more than ten ounces of zinc to the pound of copper is whitish, crystalline, hard, and brittle; of less than ten ounces it is malleable, soft, and ductile. The alloys known as pinchbeck, Manheim gold, bath metal, etc., formerly much in use as imitations of gold, are about three to four ounce brass.

Brass combines a number of excellent qualities, which adapt it for many uses. Its compactness, durability, strength, and softness, render it an excellent material for fine work, and nothing, except tin, perhaps, is better adapted for shaping in the lathe. In use it is not liable to rust by exposure, is easily kept clean, and takes a polish almost as beautiful as that of gold. It is hence a favorite material for the works of watches and clocks, almost all sorts of instruments in which great hardness is not essential, and for various household utensils, and ornaments upon furniture. In thin plates it is stamped and embossed in figures, and is thus cheaply applied to many useful and ornamental purposes. Its ductility is such, that those sorts containing little zinc are beaten out, as in Dutch gilding, like gold-leaf itself, so as to be used as a cheap substitute for this in gilding in some cases. It is also drawn out into wire, often of great fineness; and of the suitable sizes of this there is a very large consumption in the manufacture of pins, and hooks and eyes. By ingenious machinery the brass wires are clipped to their proper length for pins, pointed, headed, and after being tinned, are stuck in paper, with very little attention from the workmen. This manufacture serves to exemplify the perfection of machinery, and some of the most admirable of this, particularly that by which the finished pins are stuck in their papers, is a peculiarly American invention, and worth, to the manufacturers at Waterbury alone, many thousand dollars annually. The solid-headed pin, made somewhat after the manner in which cut nails are headed, was invented by two citizens of Rhode Island, Mr. Slocum and Mr. S. G. Reynolds. This was before the year 1840. The brass pins and hooks and eyes are covered with a coating of tin by placing them in a barrel, together with about twice their weight of tin in grains, several ounces of cream of tartar, and several gallons of warm water. The barrel is then made to revolve upon its axis, until the pins or other articles are perfectly clean. After this they are boiled in a similar mixture.

Much of the brass of the ancients was properly bronze—that is, a compound of copper and tin. This alloy, in different proportions of its ingredients, is still of very great service. Gun metal—the material of the so-called brass cannon—is composed of copper 96 to 108 parts, and tin 11 parts. The compound resists wear extremely well, but its strength is only about one-half that of wrought iron. Statues, and hard castings for machinery, are formed of this alloy. Messrs. Mitchell, Vance & Co., of New York, have been very successful in casting bronze statuettes and ornaments, clock cases, &c., which rival the antique bronze in beauty. One of the most noted foundries for the casting of cannon, statues, and bronze ornaments in the United States is that of the Messrs. Ames, at Chicopee, Mass. The equestrian statue of Washington, in Union square, New York, is one of their most successful productions. The French bronze contains 2 parts of tin, 1 of lead, 6 of zinc, and 91 of copper. Bell-metal is a bronze usually consisting of 7 parts of copper and 22 of tin. The largest bell in the country, that formerly on the City Hall, in New York, weighs 23,000 pounds, and was cast in Boston. The largest number of bells is probably produced at the foundry of the Messrs. Meneely, at Troy, N. Y. The Chinese gong is now an American manufacture, composed of bell-metal, which, after being cast, is forged under the hammer, between two disks of iron. The casting is made malleable by plunging, while hot, into cold water.

As with zinc, copper forms an alloy made to imitate gold, so with tin and nickel it forms a combination resembling silver, known as German silver. The proportions of the metals are 8 parts of copper to either 3 or 4 each of the two other metals. This is used in the manufacture of spoons, forks, and other utensils, and instead of brass in various instruments. It is plated with silver, and is as beautiful as the genuine silver.

Recently, processes of refining nickel on a large scale have been discovered, by which it is rendered as malleable as silver, retaining, however, a greater hardness. In this condition it is combined with copper, forming an alloy having all the serviceable qualities of gold; with platinum and copper forming a beautiful argentine metal.

Another alloy of copper and tin is the telescope or speculum metal, which consists of about one-third tin and two-thirds copper. It is of a steel-white color, very hard and brittle, and susceptible of a high polish, which is not soon tarnished, qualities that cause it to be used for the mirrors of telescopes.

Copper is largely used in the coinage, pure in the cent, combined with nickel in the three and five cent pieces, and as an alloy in the silver and gold pieces.

Among the later alloys of copper is what is called *oroide of gold*, which in its best qualities consists of pure copper, 100 parts; zinc or tin, 17 parts; magnesia, 6 parts; sal-ammonia, 0.5 parts; quicklime, 0.125 parts; tartar of commerce, 9 parts. *Aluminium Bronze*, 90 parts copper and 10 of aluminium.

## CHAPTER III.

### GOLD.

Although the discovery of gold was one of the motives that first led to the settlement of the American continent, the search for it in the United States does not appear to have been successful until the present century. The only exception to this statement was in the alleged discovery made by some Europeans of the gold region of northern Georgia at a period long antecedent to the occupation of this district by the whites. Of this fact no written record is preserved; but in working the deposit mines of the Nacoochee valley, in Habersham county, there were discovered, about the year 1842, various utensils and vestiges of huts, which evidently had been constructed by civilized men, and had been buried there several centuries. It is supposed they belonged to De Soto's party, which passed through this region in the sixteenth century on their exploring expedition from Florida to the Mississippi river. The earlier historians hardly mention gold as even being supposed to exist in the colonies. Salmon, in the third volume of his "Modern History," 1746, merely alludes to a gold mine in Virginia, which of late "had made much noise," but does not even name the locality, and evidently attaches no importance to it. In Jefferson's "Notes on Virginia" mention is made of the discovery of a piece of gold of 17 dwts. near the Rappahannock. In 1799, as mentioned by Wheeler in his "History of North Carolina," a son of Conrad Reed picked up a piece of gold as large as a small smoothing iron from the bed of a brook on his father's farm, in Cabarrus county, and its value not being known it was kept for several years in the house to hold the door open, and was then sold to a silversmith for $3.50. In Drayton's "View of South Carolina," 1802, the metal is stated to have been found on Paris Mountain, in Greenville district. About this time it began to be met with in considerable lumps in Cabarrus county, N. C., and not long afterward in Montgomery and Anson counties. At Reed's mine, in Cabarrus, the discovery by a negro of a lump weighing 28 lbs. avoirdupois, near the same stream already referred to, led to increased activity in exploring the gravelly deposits along the courses of the brooks and rivers of this region, and numerous new localities of the metal were rapidly discovered. A much larger proportion of gold was collected, during these earlier workings, in coarse lumps than in the operations of later times—pieces of metal of one to several pounds weight being often found. Before the year 1820, as stated in *Bruce's Mineralogical Journal* (vol. i., p. 125), the quantity of American gold received at the mint at Philadelphia amounted to $43,689. All of this was from North Carolina. In 1827 there had been received from the same source $110,000. But besides this amount, a considerable proportion of the gold product was consumed by jewellers, who paid a better price than was received from the mint, and was retained by the banks, in which it was deposited. It also circulated to some extent as a medium of exchange in the mining region, being carried about in quills, and received by the merchants usually at the rate of ninety cents a dwt. The total product of the mines must, therefore, have been much larger than appears from the mint returns. In 1829, Virginia and South Carolina began to appear as gold-producing states—there being deposited in the mint from the former gold to the value of $2,500, and from the latter of $3,500. The same year the rich gold deposits of northern Georgia were discovered, and suddenly became very productive, so that the receipts at the mint from this state for the year 1830 amounted to $212,000. Gold mining had now become an established branch of the productive industry of the states, and as its importance increased, the necessity was felt of the establishment of branch mints in the mining region. One was constructed by act of Congress at Dahlonega, Lumpkin county, Georgia, and another at Charlotte, Mecklenburg county, N. C.; and both commenced coining gold in 1838. From the irregular manner in which the gold deposits were worked, and their uncertain yield, the annual production of the mines was very variable. In a single year the mint at Dahlonega received and coined gold to the value of $600,000; and until the discovery of the California gold mines, the American production was estimated to average annually about $100,000. It was, however, gradually declining in importance from the year 1845; and of late years has dwindled away, so as not to amount to enough for the support of the branch mints, and these were abolished in 1861, but an assay office has been opened at Charlotte since the war. The introduction into the mines of North Carolina and Georgia of the hydraulic and sluice washing, which has proved highly successful in California, gives encouragement that these mines may again become productive.

Gold is found only in mountain ranges and in the valleys which divide them; and in the latter usually only in placer deposits. It is oftenest found in its native state, in grains, fine dust, or nuggets, mingled with quartz, feldspar, or schist, in veins which fill fissures of trachyte, porphyry, or other metamorphic rocks. It is one of the characteristics of the true fissure veins that they are narrow, and filled with a conglomerate of quartz, feldspar, and other rock, among which the grains of gold occur more or less plentifully. Occasionally gold is found combined with some other metal or mineral, as the gold-bearing pyrites of iron and copper, the tellurides of gold and silver, the combination with silver, and the various sulphides and sulphates which are occasionally found in Colorado, and perhaps in California; but even in these cases, it usually occurs in veins. Placer gold is deposited where the mountain torrents or the larger rivers which erode or eat out the strata of the rocks over and through which they flow, and meeting with these fissure veins in their course carry down the gold and gold-bearing quartz which they contain, with the other debris from the rocks, and deposit it in the river-beds or valleys below. The Appalachian range, a name applied to the whole mountain chain of which the Alleghanies are a part, and which extends from the Canadian province of Quebec to northern Georgia, Alabama, and Mississippi, is gold-bearing, in a moderate degree, throughout most of its course, as we shall presently show; though but few of the veins, and still fewer of the placers, render a very generous return for the labor expended on them. The Mississippi Valley, and the prairies on either side of it, contain no gold, nor does there seem to be any considerable quantity in the upper peninsula of Michigan, but the Black Hills and the Bighorn range, eastern and outlying spurs of the Rocky Mountains, have many veins which yield the precious metal, if not in large, yet in very constant quantity.

When we come to the three or four ranges which go to make up the Rocky Mountains, we find all along the chain and in the spurs and cross ranges abundant evidence that the whole mountains are permeated by veins of gold bearing quartz, at not distant intervals from Alaska to the Gulf of Mexico. It was thought at one time that only the easternmost of these ranges contained gold in very large quantities, but it is now certain that the main range, or "Great Divide," as the miners call it, and even the somewhat lower western range, contain veins and lodes of both silver and gold in still greater abundance. It is probable, though not absolutely certain, that the Wahsatch range, which with its spurs forms the eastern wall of the great Utah basin, is gold-bearing; but the Sierra Nevada, whose eastern range forms the western wall of that basin, and which extends under various names and with numerous spurs and short ranges through Arizona and southeastern California into Mexico, is exceedingly rich in silver and gold, and its northern extension, the Cascade Mountains, has given abundant proof that it, also, is gold-bearing. The Coast Range, also, from Washington Territory or British Columbia to the peninsula of Lower California, has, at many points, yielded up its treasures, while the golden sands of Del Norte, Humboldt, and Mendocino counties, in California, show that they have been washed down from the mountains of the Coast Range, for the law has no exceptions, "no mountain vein, no placer."

Having thus passed in rapid review the sources from which gold is derived, let us now take up more in detail the localities in which gold has been discovered in paying quantities.

A gold mine was opened in 1851–2 in the province of Quebec, on the Chaudiere river and its tributaries, the Du Loup and the Touffe des Pins. This was a placer deposit; about 1,900 pennyweights were discovered and collected, but the returns were not sufficient to cover the outlays, and it was abandoned. In Vermont, at Bridgewater, Plymouth, and Newfane, there have been some attempts to open gold mines; but though they have struck the veins or lodes, they were not sufficiently rich to be successfully worked. In Massachusetts, Connecticut, New York, and New Jersey, gold has been found recently along the line of these mountains, and specimens of quartz rich in gold have been produced in Montgomery county, Penn. In Virginia, the placer mines of Louis Co. especially were very productive, even in 1833, and they had not been worked long before rich veins were traced up, and operations upon these had been carried on to considerable extent previous to 1836, principally in the counties of Spottsylvania, Orange, Louisa, Fluvanna, and Buckingham. Some of the mines produced at times very rich returns, but their yield was, for the most part, exceedingly irregular, the gold occurring in rich pockets or nests, very unequally scattered in the vein. The occasional richness of the veins caused the attention of wealthy capitalists in this country and in England to be directed to this region, and large outlays were made, in providing powerful engines and other suitable machinery for working the ores, and in opening the mines. But, although the operations have been directed by the best mining skill, supported by abundant capital, the enterprise, on the whole, has not met the expectations of its owners. The entire production of gold in Virginia, from the beginning to June 30, 1880, was $1,672,667.70, but there has been a decided falling off during the last decade. In 1880 there was only $9,322.07 deposited at the mint and assay offices, and the average of ten years was only about $15,000.

In North Carolina numerous quartz veins have been worked during the last fifty years, and operations are still carried on with considerable success at mines in Guilford, Davidson, Montgomery, Cabarrus, Rowan, and Mecklenburg counties. Placer mines have been worked with great success, also, in Burke, Rutherford, and McDowell counties. At a single time, it is stated, there might have been seen, from one point of view in McDowell county, no less than 3,000 persons engaged in washing the deposits. In this district sluice-washing has recently been successfully introduced by Dr. Van Dyke, who is also engaged in the same process in Georgia. The most important group of mines is at Gold Hill, on the southern line of Rowan and Cabarrus counties. Mining operations were begun here in 1843, and for ten years the annual product averaged about $100,000; the last four years of this period more than one-third of all the gold coined at the Charlotte mint was from Gold Hill. In 1853 the property was purchased by a New York company, by which it has since been worked, but with greatly reduced profits, although the mines have been furnished with the most efficient machinery. These are the deepest gold mines in the Atlantic states, one of the shafts having now reached the depth of 680 feet. The ore is pyritous iron, containing gold in particles rarely visible, and probably chemically combined with the iron and sulphur in the form of a double sulphuret. It is separated with difficulty, and very imperfectly, by the processes of crushing and amalgamating; and the immense heaps of tailings collected below the mines, amounting probably to over two million bushels, still retain quantities of gold worth from fifty cents to two dollars the bushel. The Washington mine, in Davidson county, opened in 1839, after producing considerable gold, was thought to be more valuable for silver than for gold. It is the only silver mine of any importance east of the Rocky Mountains, but up to June, 1880, it had yielded only $45,581.33 of silver. The yield of the precious metals from North Carolina, however, has been considerably greater than that of any other of the states east of the Rocky Mountains, aggregating $10,658-932.43.

Although many gold mines have been worked in South Carolina, the only one of much note is the Dorn mine, in Abbeville district. In 1850 this mine, then quite new, produced gold to the value of $19,-000, and in 1852 the production rose to $202,216. This large yield was caused by finding pockets or chimneys in the vein, soon fell off, and the production of 1880 was only $11,861.70, and that of the state from the beginning to June, 1880, was $1,401,875.74.

The Georgia gold mines, first worked in the northeast part of the state in 1829, were soon found to extend southwest into the country beyond the Chestatee river, which was then possessed by the Cherokee Indians. In 1830 the borders of this territory were overrun by a reckless set of adventurers, notwithstanding the attempts made, first by a force of United States troops stationed for the protection of the Indians, and afterward by Georgia troops, when the state extended her laws in 1830 over the Cherokee country. On the removal of the Indians, their lands were distributed in forty-acre lots, by lottery, among the inhabitants of the state, and thus titles were obtained to the gold mines. The placer mines yielded richly for a few years, and the whole product of gold for the first ten years of their working is supposed to have amounted to $16,000,000, a large portion of which never reached the United States mints, but was distributed in barter throughout the neighboring states, and worked up in jewelry. From 1839 to 1849 the production did not probably exceed $4,000,000. A number of quartz veins were opened in Habersham, Lumpkin, Cherokee, Carroll, Columbia, and other counties, and considerable amounts of gold were obtained from these. They were, however, generally abandoned when the workings reached a depth at which machinery would be required for draining the mines. In Columbia county, about twenty miles from Augusta, the McCormack mine has been worked without much interruption for about forty years, producing very fair profits. The gold is found in small particles in a honey-combed quartz, which contains but little pyrites and some galena. Nearly all the gold was obtained within seventy feet of the surface.

In Lumpkin county the gold is found in immense placers of decomposed micaceous and talcose slates, and an effort was made to work these placers by the process of hydraulic mining as early as 1858 by Dr. H. M. Van Dyke, who had lived in California in the mining districts. Dr. Van Dyke secured the coöperation of Boston capitalists, and purchasing large tracts of land near Dahlonega, commenced operations in 1858, and was very successful for the next three years. Another Boston company followed his example, and established themselves in White county, and utilized the Nacoochee river for their purpose. Between 1837 and 1861 the branch mint at Dahlonega had coined $6,121,919, mostly Georgia gold. The war put an end both to the hydraulic mining and the minting of the bullion. After the war the mint was abolished, and for some years there was no attempt to resume mining operations. In 1873 efforts were made to renew work there, and in 1880 Georgia sent to the mint $89,831.08 of gold. Her entire production up to June, 1880, has been $7,698,540.23.

From Georgia, the gold-bearing rocks are traced into eastern Tennessee, where they have been worked along the range of the Coweta and Smoky Mountains. The production of this state has not been large, aggregating in forty years only $84,266.25, and amounting in 1880 to only about $12,000. And from the south side of the Blue Ridge, in Georgia, they have proved productive in a southwest direction, through Carroll county, into Alabama. The mines in this state were placers mainly, and after yielding moderately well for a number of years, producing in all $219,873 to June, 1880, they have fallen off so completely that the production of 1880 was only $753.

But all these gold mines east of the Mississippi, with their production of about $22,000,000 of gold in fifty years or more, sink into insignificance when brought into comparison with the vast production, both in gold and silver, of the region west of the Mississippi. While some portions of this great western empire had been worked for gold by the Spaniards and natives two centuries ago, as was the case in New Mexico, Arizona, and possibly in Colorado and Wyoming, these mines had been abandoned till the explorations which followed the discovery of gold in California, in 1848, brought to light the hidden treasures of the hills. The mining excitement, or fever, has had its remissions and exacerbations; but at no time has it been so wide spread, or its discoveries so numerous, as since 1876. Of the twenty-one states and territories lying west of the Mississippi river, gold (and in most, silver) mining is actively prosecuted in twelve, and gold is known to be present, in paying quantities, in two more, Texas and the Indian Territory. The gold states and territories, beginning at the west, are California, Oregon, Washington, Idaho, Nevada, Utah, Arizona, New Mexico, Colorado, Wyoming, Montana, and Dakota. Of these, California was the first to produce gold in great abundance, and has held its pre-eminence, though Colorado is, in its present production, not far behind; while Montana, Idaho, Oregon, and Nevada, Arizona, and Utah, bring up the rear—the last three being more prolific in silver than in gold.

In the thirty-three years since the discovery of gold in California, this great western region has yielded over $1,800,000,000 in gold, a sum more than equal to our entire national debt, and this is but the beginning of gold production, for though placer-mining, except by the hydraulic process, and in the newer gold fields, is nearly at an end, the discoveries of the last three or four years have developed such rich and permanently productive veins, and so many new forms of gold mining, that the annual product of gold is increasing. The gold product of 1880 exceeded $36,000,000; that of 1881 exceeds $37,000,000. The remaining eighteen years of the present century cannot fail to advance the total output of gold to $2,600,000,000, while that of silver, though very large, will hardly amount to more than one-third of that sum.

Let us now describe, as briefly as we may, the different methods of mining and of extracting gold from its earthy or metallic combinations and attachments. As we have already said, gold may be found in placers, or in small nuggets, in grains, or coarse or fine dust, in the bed of streams, or on the sea-shore; it may occur as free milling gold, in veins or lodes of quartz or conglomerate, or it may be combined with sulphur, tellurium, silver, copper, iron, zinc, or lead in ores, and often with more than one of these at the same time. Each condition requires a different mode of treatment. In placer-mining, the primitive method was the use of the *pan*; a large milk-pan being partly filled with the earth supposed to contain gold, was taken by the miner to a neighboring stream and filled with water, and then shaken violently, till its earthy contents were suspended, and by gentle tipping washed away, and the more solid gold particles settled to the bottom. This process was wasteful, particularly if the gold was in fine particles; so the *rocker* was substituted, something like a child's cradle of the olden time, with one end considerably lower than the other, and at the upper end a riddle or colander, with holes of considerable size; underneath the riddle was the floor of the rocker, provided with cleats or riffles extending nearly across to catch the gold. In each riffle was placed some quicksilver, which combined with the gold forming an amalgam, provided there was no oil or grease to prevent the union. This saved more, but did not work fast enough. Next came the "*Tom*," a longer and larger rocker, twelve or fifteen feet in length, also provided with a riddle, cleats, or riffles, and the quicksilver for amalgamating the gold. This required three men, one to pump the water into the Tom, one to throw in the pay-dirt, and another to throw out the stones and throw the undissolved lumps back into the riddle. To this succeeded the *sluice*, a trough of boards made water-tight, and from a hundred to five thousand feet in length, with its riffles and quicksilver, and provided with water which ran through it constantly, by a flume or canal from some mountain stream or lake. The difficulty now was to obtain sufficient laborers to throw in the pay-dirt with such rapidity that none of this costly water should be lost. The next step was *hydraulic mining*. The large pan or riddle of the great sluice was still farther enlarged, and so placed that the earth from a neighboring hill or bluff which contained gold would fall into it, and the water conveyed by a flume often for many miles, and with a head of from sixty to two hundred feet passed through a strong hose to a nozzle two inches or more in diameter, was directed upon the hill, breaking it down, pulverizing it, and forcing it in a muddy current through the perforated sluice. Bars were placed across the sluice at such an angle as to turn aside the larger stones and boulders, and four or five men could accomplish more and gain larger returns than four or five hundred by the old processes. Sometimes the clay which bound together the gold-bearing gravel and sand proved too tough to be broken down even by the force of the hydraulic stream, and then the miner tunnelled the base of the hill, and introduced a heavy charge of giant powder, gun cotton, or dynamite, which, when exploded, disintegrated the tough masses, and made the task of the hydraulic pipe easy. This process has brought many millions of gold bullion into the market, and kept up the gold production. It fails, however, in some cases, and the tailings contain a good deal of gold in all cases, which the patient Chinese, by repeated washings, obtain in sufficient quantities to give them from two to five dollars a day.

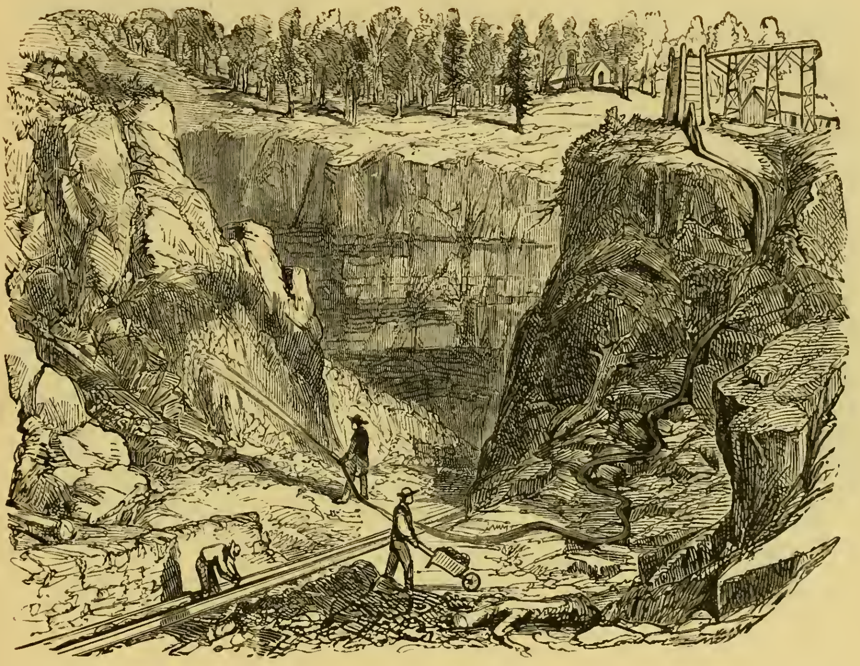
On the Snake, Salmon, and Wood rivers, in Idaho, the gold was deposited in the finest possible powder, in an equally fine clay, and though the assays would show from $10 to $50 of gold to the ton, and sometimes even more, it was impossible to extract by the ordinary process of washing more than from $3 to $5 per ton. This difficulty was finally obviated by placing in the sluice, at short intervals, sheets of boiler iron, electro-plated with silver, and then covered with quicksilver; in some cases both surfaces were coated, and they were so arranged that the flow of water would cause them to partially revolve on each other, thus causing the gold-bearing clay to be ground between them. This process was found to be considerably successful. But the placers become exhausted after a time, and being traced back to their source, they are found to come from veins or lodes in the hills or mountains, where the gold is either "free," as it is called, in quartz or conglomerate, the veins being generally narrow, and occupying a crack or fissure in the different slates, the granite, gneiss, trachyte or porphyritic rocks, or is found in ores more or less refractory, composed of sulphides of iron, copper, zinc, or tellurium, or with silver, in some combination, with lead, zinc, copper, or tellurium, in veins or lodes, in the same classes of rocks.

The processes of mining for gold in these veins—quartz mining, as it is usually called—are entirely different from those of placer-mining. Gold may occur in true fissure veins, or in pockets or chimneys, or in what Prof. Newberry calls mechanically-filled veins, as at the Bull Domingo mines, in Custer county, Colorado, but, unlike silver, it seems never to occur in what are known as contact lodes, like the carbonate belts at Leadville and elsewhere. The true fissure veins may have, and often do have, chimneys, chutes, pockets, bonanzas, or branch fissures, generally connecting with the main vein or lode on its upper side, at an angle of from thirty to forty-five degrees, and these branches, etc., may be richer than the main vein, but they are not generally of any great extent.

The main gold-bearing vein or lode follows the dip of the stratum in which it is located, and hence may be at any angle with the surface. They generally penetrate to a great depth, and often the gangue or vein matter which is charged with gold is softer and more easily worked at a considerable depth than near the surface. The veins vary greatly in productiveness at different depths, there being not unfrequently barren tracts of quartz, miniature boulders which block up the whole vein, and which have given the name of "boulder veins" or "horses" to these tracts. When, from the presence of these boulders or other causes, a vein becomes barren for a considerable distance, there often succeeds a space, which is filled up with soft and decaying quartz, and is rich in gold. "A distinctly marked banded structure," says Mr. W. P. Blake, "with a more or less crystalline medial plane is not uncommon where veins traverse a hard homogeneous rock, such as granite or syenite. This is a structural arrangement of the gangue, which is regarded as one of the characteristics of true fissure veins. A banded structure, due chiefly to the parallel arrangement of the pyrites, or to enclosed films of slate, is often seen in veins traversing slates. Such veinstone is often known as "ribbon quartz," and is considered by miners as favorable to the richness of the ore. There is a class of veins known as "slate veins," in which a belt of slates is traversed by thin seams of quartz so much divided up into films and mixed with the layers of slate as scarcely to be recognized. Such seams, perhaps not thicker than a card or a knife-blade, are sometimes highly charged with gold."

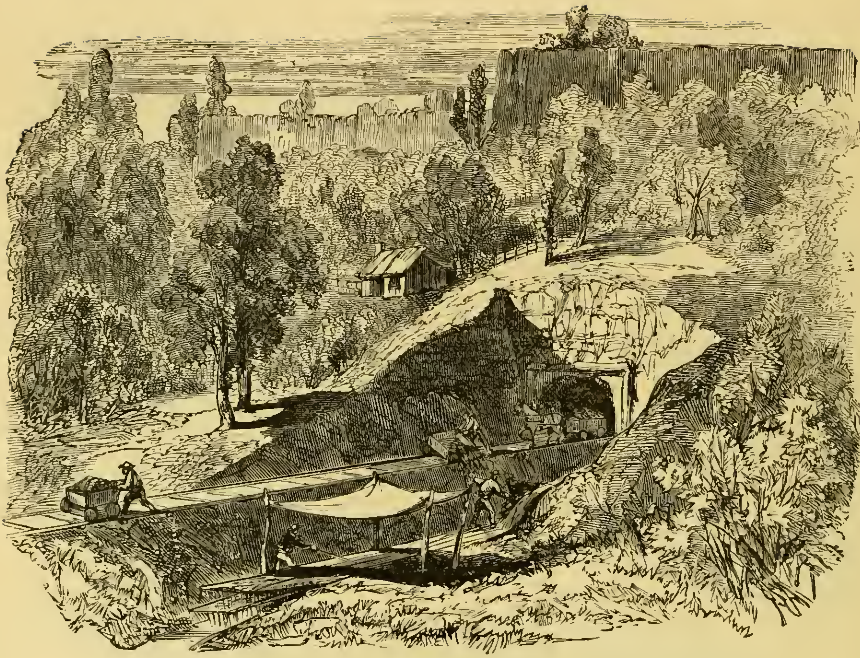
The gold in many veins, especially in Colorado, Utah, and Montana, is not "free," *i. e.* not pure gold or gold only mixed with silver, but is associated and sometimes chemically combined with pyritous minerals, such as sulphuret of iron, yellow copper ore, galena, arsenical pyrites, tellurium, and the tellurides of bismuth or other metals. The amount of these pyritous minerals may not be large, but some of them constitute the most refractory ores known to the metallurgist. The tellurides in Colorado for a long time resisted all efforts for their reduction, except by processes so expensive as to consume all the profits. They yielded at length to the chloridizing processes, and of late to an electric process, which is said to be still cheaper and easier.

But it is time we described the ordinary processes of gold lode mining. It does not vary greatly from the mode of mining for copper, already described on page , except in these particulars: the veins are generally narrower, the rock in which they are enclosed harder, and the mines penetrate to a greater depth. The vein, or what is hoped may prove such, being discovered, and its course ascertained as far as possible, the miner stakes off and records his claim in accordance with the mining laws of the state or territory, which give him, on certain conditions, a width of from 150 to 600 feet, and a length on the course of the vein of from 600 to 1,500 feet. This matter settled, he proceeds to work his claim. At first he sinks a shaft, an excavation of perhaps 10x12 or 10x15 feet on the line of the vein. For the first 50 or 100 feet, this shaft can be dug with only a windlass, with crank and bucket for hoisting the ore, waste rock, and water, driven by one or two men. For the next hundred feet, horse-power, used with a whip or pully, or with a whim or large drum of timber, around which the rope winds and unwinds as the bucket ascends or descends. Beyond two hundred feet the man-power and horse-power give place to the steam engine and its hoisting apparatus, and if water rushes in huge steam pumps are required. At the depth of 50 or 100 feet, and generally at every 50 or 100 feet thereafter, a level is run—a horizontal chamber eight or ten feet in height—following the course of the vein or veins, and extending perhaps 50 or 60 feet from the shaft; sometimes a level is connected with the one below it by a shaft running from it to the level below, but not reaching to the surface. This is called a winze. These levels require to be supported by timbers, even though the rock in which they are cut may be very hard. For the most part, also, the shafts require to be lined with timber, both for protection from water and from falling rock. There are often several minor veins running parallel or at angles with the main vein, and these are laid open at some point in their course, either by the shaft or levels. When a vein is located on the top of a hill, or on its slope, it is often reached most readily after sinking a shaft by tunnelling toward the shaft from the base of the hill; in this way, also, the water, if troublesome, can be drawn off, from the upper levels at least. The sinking of the shaft and winzes, and running the levels and the tunnel, if required, are called "dead work," as, except incidentally, there is no direct yield of the ore or vein-stuff obtained in their construction; but when these are completed, the profitable work of the mine begins. The miners, with their picks, extract the ore or quartz from the veins, either bringing it down from the walls above them, or on the



HYDRAULIC MINING.

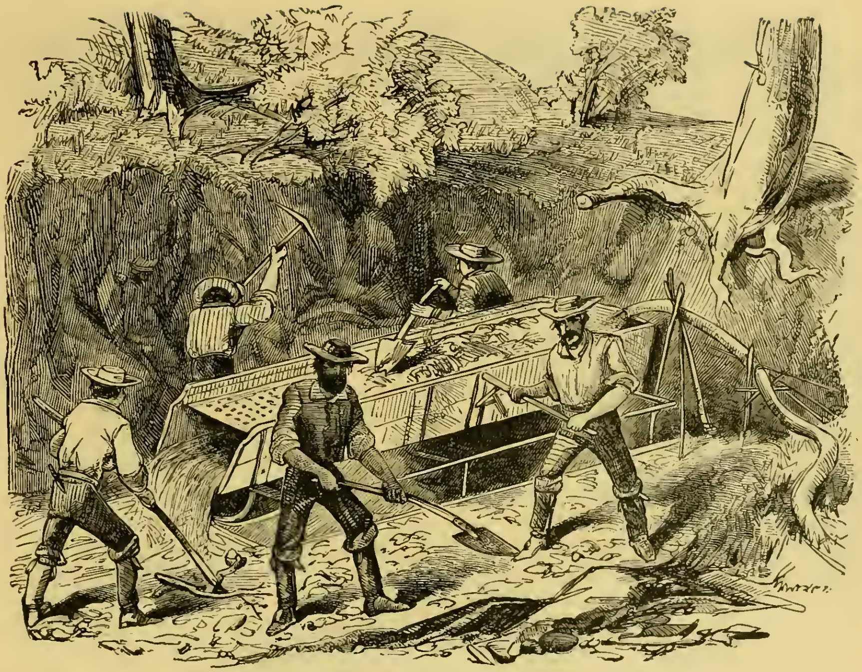
By this operation, as described in the text, hills of loose materials or of decomposed slates and other rocks containing gold, are washed down, and the earthy matters are swept away through the sluices made either of wooden troughs or by excavating channels in the bed-rock. In these the coarse gold is caught against the bars placed at intervals across the sluices. This is a purely Californian method, and has proved so effectual in collecting the little gold buried in large bodies of earth, that it is now generally adopted in other gold regions in which the conditions are favorable for its practice.



TUNNELLING AT TABLE MOUNTAIN, CALIFORNIA.

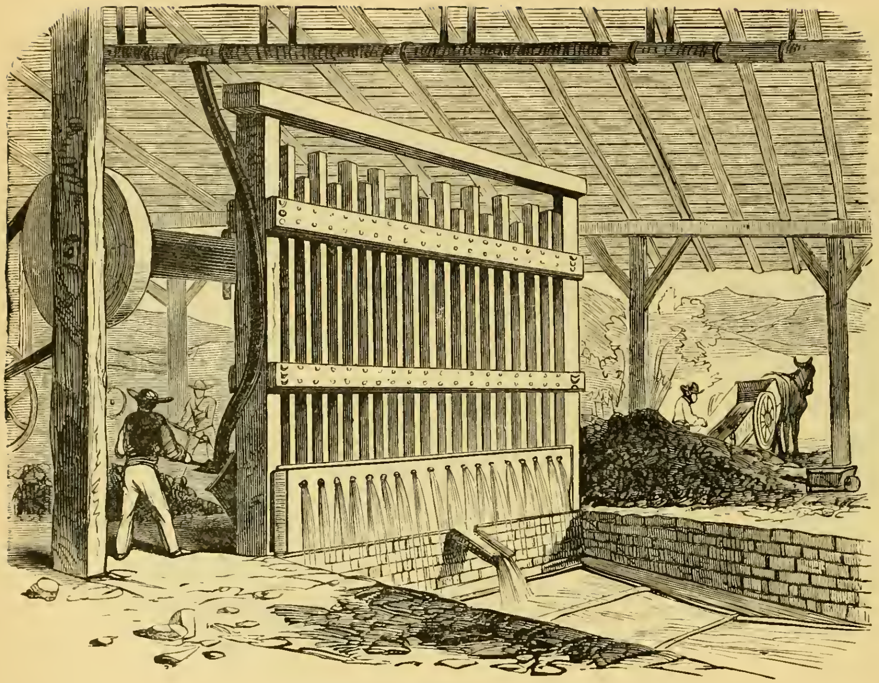
This represents a common method of reaching beds of rich ores that lie at considerable depths below the surface, by which the labor of removing the superficial deposits is avoided. Veins of ores, whether lying at a steep or gentle inclination, are often explored by such tunnels driven in upon their course. The sides and roof may be protected or not, as the ground is soft or solid, by timbering.

At the outside of the tunnel below the railroad track is the machine called the "long tom," a shallow trough, ten to twenty feet long, and about sixteen inches wide. The lower end, which turns up gently from the plane of the bottom, is shod with iron and perforated with holes. The water from the mine is turned on the upper end, and flows up this slope and through the holes, carrying with it the finer mud and sand which are continually thrown into the tom. One man at the lower end keeps the mud in motion and removes the coarse lumps. Under the lower end of the tom is placed a "riffle box," in which mercury may be used to advantage if the gold is in fine particles.



LARGE ROCKER USED IN CALIFORNIA WITH QUICKSILVER.

The above cut represents a rocker of unusual dimensions, which has been introduced in some places in California, and is employed particularly for auriferous deposits in which the gold is in too fine particles to be caught in the long tom. It is slightly inclined, and is rocked by one man while the others collect the gravel and throw it upon the perforated iron plate. Across the bottom of the trough are placed "riffle bars," and behind each one of these some mercury. The fine particles of gold coming in contact with this are caught and retained in the form of amalgam. The coarse gravel falls off the lower end of the plate, while the fine mud and sand are washed by the water through the holes in the plate.



STAMPS FOR CRUSHING GOLD ORES.

This cut represents a common form of stamps, such as are used for pulverizing auriferous quartz or other ores. They are variously arranged at different mills; sometimes four or five running in one set, and several sets being placed on the same line, but separate from each other. This arrangement is more convenient for stopping a portion at a time as may be required for repairs or for collecting the very coarse gold under the stamps which cannot pass through the grating or the plates, perforated with many holes, that are usually employed in front of the stamps.

sides of the level, which is called "overhand stoping;" or digging it from the floor of the level, which is "underhand stoping." In all the larger mines tracks are laid along each level to the shaft, on which cars are run, which, when filled with the ore or waste rock, are hoisted to the surface. Sometimes, when the vein rock is very hard, hand drilling has to be resorted to, to break it out. But the ore, being brought to the surface, a specimen of it is assayed, and its yield to the ton approximately determined. No ore, on reduction, and no free gold, under the stamps, ever realizes fully the amount per ton which the assayer assigns to it. In the early mining in California, under the wasteful processes of their imperfect machinery, forty per cent. of the assay was the average yield. Under the improved machinery of the present day, the free milling gold gives up from seventy-five to eighty-five per cent.—the pyritous ores something less.

If the vein-stuff contains only free milling gold, and a stamp-mill is at hand, it is crushed by the stamps, or if the pieces of quartz are large, and the wall rock adheres to a considerable extent, it is first put into the rock-breaker and the size reduced to that of an English walnut or an egg, and then put in the stamp-mill. The mill proper, consists of a solid framework, heavy iron stamps and attachments, propelled by steam or water power by means of a horizontal shaft and connections. Mortars, inclined tables, and other accessories go to make up the contents of the establishment. The framework is upright, as are also the iron stamps, which are made to rise and fall by means of cams or arms extending from the revolving shaft above. The stamps rise from twelve to eighteen inches and drop on the ore in iron mortars or troughs beneath from twenty-seven to thirty-five times per minute. These mortars are several feet long, and from twelve to fourteen inches high, and nine or ten deep, and rest on solid wooden foundations. They are placed between the upright wooden posts of the frame; the stamps, usually five in number, that rise and fall thereon, form what is termed a battery. The mortars are the receptacles for the ore, which is shoveled or fed into them as fast as it can be advantageously crushed by the stamps, at the same time that a constant stream of water flows in the same direction. Some mills have but a single battery of five stamps; others have ten or twenty, and there are some that have from seventy-five to one hundred and fifty.

On the side of the mortars where the ore feeding is done, the framework is boarded up some distance, and on the other side are sheet-iron screens, through which the pulverized ore and water is forced on to the sloping copper-plated inclines or tables below. Quicksilver is fed into the batteries and upon the tables when the mill man deems it necessary. This retains most of the gold on the tables, while the pulp or slimes from the batteries are being carried onward by the water to the buddling tanks or stream beyond. The stamps are stopped, the water turned off, and the mortars and the plates of the table are cleaned once a day, or once in several days, and the amalgam, or gold and quicksilver combination, is taken to the retort-room. Here it is skimmed and cleaned and pressed in a cloth so as to get rid of as much of the quicksilver as possible; the remainder is retorted, and the crude bullion sold at the banks at from fourteen to eighteen dollars per ounce, or shipped in other ways. Gold from different mines varies in fineness and value, the quantity of silver accompanying it having much to do with this. The average fineness of Gilpin county, Colorado, bullion or retort gold is 787 parts of pure gold, 198 parts pure silver, and 15 parts copper. The bullion obtained is from one-fourth to one-half of the amalgam, but rarely the latter. The quicksilver, after being condensed, is saved for future use.

After the pulverized ore leaves the batteries it is usually washed over two sets of inclined tables—the lower ones being covered with blankets. Some mills use pans, modeled after the principle of an arastra. The pulp or slimes, on leaving the mill proper, are generally worked over or concentrated by washing or buddling, when the concentrates are sold to the smelters. This often adds a dollar or two per ton to the total receipts from the ore. Formerly no effort was made to save anything beyond the tables. About one ton of these tailings can be saved and sold to every ten tons of ore crushed.

The stamps used in these mills weigh from five hundred to seven hundred pounds, are generally ten or twelve feet high, and consist of a stem, head, shoe, and a collar, by means of which the cam raises them. The stem is made of wrought iron, and is from two to three inches in diameter, while the shoes attached to the lower part of the stem, and which come in contact with the ore, are thicker, and are made of steel or hardened iron. These stamps crush the ore to a pulp or powder, and much of the gold contained therein falls to the bottom of the mortars, and is taken up by the quicksilver placed there. Other portions of the gold are caught on the tables, blankets, and in the pans. The stamp-mill affords the only method of treating the low-grade ores, of which the veins are mainly composed. Something like 140,000 tons are crushed in the Gilpin county, Colorado, mills every year, and a still larger quantity in the great mills of the Deadwood belt, in Dakota. The smelting works are the destination of the high-grade mineral, from which they save nearly all of the gold, silver, and copper.

The quartz mills used in 1859 were primitive affairs, with wooden, unplated tables, and had only from three to six stamps each. Up to this time, the surface-dirt and soft outcroppings of the veins had been shoveled into and washed in sluices, while other material was treated in arastras. Copper plates on tables, and cyanides, were not used at first, and few of the mill men knew anything about treating ores. It took a decade to bring quartz milling into even passable shape, and nearly another to get it up to its present partly satisfactory condition.

This detailed account of the quartz mill is given because it is the basis of some other processes, and enters into their constitution more or less. All ores must be pulverized before the silver and gold is extracted, and this is done either by stamps or by crushers and rolls. One or the other is found in all reducing, smelting, sampling, and concentrating works.

Smelting with lead riches is carried on at several points in the west. The lead comes out in bars, and the silver and gold in other bars. No copper is saved.

Chlorodizing-roasting and amalgamation is practiced at several places in Colorado, Utah, California, and Montana, and at Omaha and St. Louis. The ores are first broken in Dodge crushers and Cornish rolls, dried, sampled, and assayed, and then crushed dry by stamps, after which they are roasted in revolving iron cylinders, and then amalgamated in pans. Separation then takes place in the melting-room, and bars containing from $1,500 to $1,800 each, and of a fineness of from 800 to 900, are melted and ready for shipment.

The pulverized ores are placed in the cylinders in charges of 3,500 pounds, more or less, and the cylinders are then revolved at the rate of one revolution in two minutes. After four hours, from six to eight pounds of salt are introduced for every one hundred pounds of ore. Caribou ores require only from eight to eleven hours of roasting, and Georgetown ores from ten to twenty, according to lode. From 2,000 to 2,500 pounds of the roasted ore goes into each amalgamating-pan or leaching-tub at one time. In the pans, mullers do the grinding, and after one or two hours from 350 to 400 pounds of quicksilver are added, when the grinding continues from eight to twelve hours longer. The pulp is then thinned by water, and the specific gravity of the quicksilver and of the silver it has attracted causes it to seek the bottom of the pans, when it is drawn off, the pulp or dirt discharged, the amalgam still adhering removed, and the pans made ready for another charge. Retorting and melting into bars closes the proceedings.

Chlorodizing-roasting and leaching is carried on at Georgetown and Rosita, Colorado, and in other states. The same kind of crushers, stamps, and roasting cylinders or furnaces are used as in the process just described, and the work is the same until the ore has been roasted. It is then placed in large agitating tubs, partially filled with a concentrated solution of hot water and salt kept in motion. This liquor extracts the chloride of silver, and with the silver in solution is siphoned off, and conducted into and through a series of tanks containing upright copper plates setting at intervals one behind and below another. The silver precipitates itself on these copper plates, when the brine or liquor is pumped back again into the agitating-tubs for use.

The blast smelting furnace is used on ores carrying a high per cent. of lead. When no roasting is required, as on carbonate ores, the process is rapid and somewhat simple. Skilled labor, attention, and experience are required, however, or disastrous results are likely to ensue. These furnaces are constructed of sheet iron, and are usually circular in shape, and of much greater height than diameter horizontally. Some are of square or oblong shape. They are built so that ore, coke, charcoal, and slag or iron are fed from an upper floor into the body of the furnace, while the lead and silver bullion and the slag make their way from separate outlets at the base of the furnace and in the story below. The hot liquid, composed of lead and silver or other metal, is ladled out into the moulds made for the purpose, and cools into bars called base bullion. The interiors of these iron furnaces are lined with brick made of fire-clay.

A reverberatory furnace is constructed of brick. The various compartments, hearths, or chambers, in which the fires are kept up and the pulverized ores roasted. are lined with fire-brick. These furnaces are often forty or sixty feet or more in length, and are divided into connecting hearths. The ore, while being roasted, is moved along from one hearth to another, by means of long iron shovels, reaching into the furnace. These furnaces are used in the large smelting works, except at Leadville.

Concentration is a method of separating the valuable portions of low-grade ores from the gangue, in order that the miner will have the expense of smelting a smaller number of tons while securing nearly the same total value. There are two systems of concentration, known as dry and wet. Each embrace a great deal of machinery. There are crushers, rolls, stamps, screens, jigs, hoppers, tables, elevators, etc., in one or both processes. The Krom, or dry process, is represented in the Clear Creek Company mill, at Georgetown and elsewhere, and the Collom and other methods at Black Hawk, Silver Plume, Idaho Springs, and Spanish Bar, Colorado, and in other states and territories. The machines known as frue vanners are used in Colorado, Utah, Idaho, and Montana. By the above-named mills the crude or low-grade ore is dressed and separated, so as to leave only marketable and paying mineral in place of rock too poor to sell to the smelter.

While, as we have said, thirteen or fourteen of these western states and territories are gold-producing, the principal interest centers about those regions traversed by the Rocky Mountains and their outlying branches, the Sierra Nevada and the coast range. A distinction is also to be drawn between those states and territories in which gold predominates and those where the largest production is of silver, for, though there is no State or territory among those which produce largely, in which both metals are not found, yet, while California, Dakota, Colorado, Nevada, Montana, Idaho, and Oregon are the largest producers of gold, the order of silver producers is: Colorado, Nevada, Arizona, Utah, Montana, Idaho, while California produces less than a million of silver.

California takes the lead, not only of all our own states and territories, but in the present century of all other States or districts in the world, in the production of gold. From January, 1848, to June 30, 1881, a little more than 33 years, California had deposited in the mints and assay offices of the United States $709,624,600.24 of gold bullion and $2,314,748.72 of silver. Those writers on metallurgy who have given the subject the longest and most careful examination, say that the amount which did not go into the mint or assay offices, but which was sent to Europe, to South America, to China, used in manufacture of jewelry, chains, watch cases, etc., etc., or which came east in private hands, was much more than equal to that which was sent to the mints; so that we have a production of over 1,500 millions of gold from this one state in 33 years.

The existence of gold deposits in California had been mentioned by Hakluyt in his account of Drake's expedition of 1577–79, and by Cavello, a Jesuit priest, who visited the present site of San Jose, and published an account of the country, in Spain in 1690; and by hunters and explorers many years later, but it does not appear that any efforts were made to mine it until Mr. James W. Marshall, who, with several others, was digging a race for a saw-mill at Coloma, about 35 miles eastward from Sutter's Fort, on the 19th of January, 1848, discovered some pieces of yellow metal which he believed to be gold. He knew nothing of metallurgy, but he continued to collect these pieces, day after day, his companions laughing at him, till about the middle of February, when he sent some of them to San Francisco to learn whether they were really of any value. His messenger fell in with Isaac

Humphrey, who had been a gold miner in Georgia, and who recognized at once the value of the deposit, and came to Coloma and commenced working it. Persons from other portions of California came to see the wonderful deposits, and returning to their homes commenced digging for gold in situations similar to those in which it had been discovered at Coloma, and in every instance they were successful. Before the first of June every portion of California resounded with the cry of gold! gold! gold! and every kind of business was abandoned to dig for gold. Soldiers left their camps, sailors their ships, farmers their farms, and traders and mechanics their stores and shops and devoted themselves to gathering the precious metal, and by the end of 1848, every large stream on the western slope of the Sierra Nevada was crowded with miner's camps.

All these diggings were for placer deposits. As yet, and for some years later, nothing was known of the veins in the mountains or of the processes of quartz mining.

It is worthy of observation that this discovery was made ten days before the treaty of Guadalupe-Hidalgo, which ceded California to us, was signed, and three months before the ratified copies were exchanged. Had the discovery been made a few months earlier it may well be doubted whether Mexico would have parted on the terms she did with what proved to have been the choicest jewel of her crown.

The various methods of placer mining were resorted to, in all parts of the state, including hydraulic mining on a gigantic scale, among the ancient placers in the former beds of rivers, whose course had been changed many thousands of years ago, by volcanic action; and though in the northwest counties and in some of the mining districts of the central and southern counties, it is still successfully practiced, yet all of the shallow placers in the older counties have been abandoned or given up to the Chinese, who manage to gather a moderately good income, from working over the tailings.

Quartz or vein mining was commenced in Grass Valley in 1850 and in Mariposa in 1852, but neither there, nor anywhere else in the state, did it prove successful before 1858. The gold product of the state from 1850 to 1860 averaged over 55 million dollars a year, rising in 1853 to 65 millions. Since 1860 there has been a falling off in the production, which for the next ten years did not average quite 45 millions, and from 1870 to 1880 was below 20 millions. In 1881 it was about $19,000,000, an advance on the previous year, and is now again on the "upward curve." The gold production of the entire United States in the fiscal year 1881, is estimated by the director of the mint at $36,500,000, so that the product of gold in California is still more than half that of the whole country.

The Black Hills in Dakota, though late in coming into the contest, now yield more gold in a year than any other district, except California. The first mining here was placer mining, and though there may have been some gold washed out in pans earlier there was no systematic mining till the spring of 1876. In five years these mines had produced $15,644,852.78 gold, and of this, the product of the year ending June 30, 1881, was $4,500,000. The gold now produced is almost entirely from quartz veins, and is free milling gold, though the ore is not generally rich; but owing to the favorable situation of the mines and stamp-mills, ores yielding $8 to $10 to the ton, uniformly can be profitably worked.

Montana has produced a large amount of gold since 1862 or 1863, a single placer (Alder Gulch, now Virginia City) having produced over $73,000,000 in gold up to the present time, and two other gulches about $16,000,000 more. Of late the gold product has been diminishing and that of silver increasing. The gold product of the fiscal year 1881 was reported as $2,500,000 and that of silver about the same. The entire gold product of Montana since 1862 is probably not less than $125,000,000. It is now mostly quartz mining, though there are many rich placers not yet worked.

Colorado began with gold placers and gold mines in 1859, and produced very little silver till 1870, and less silver than gold till 1872; the discoveries of the carbonates of lead and silver in Lake county in 1877, have greatly increased its silver production, and for a time its gold production fell off, but it is now again increasing. In the calendar year 1881 it is reported as exceeding $4,000,000, and the total gold production since 1859 is stated to have exceeded $61,000,000, and that of silver $72,000,000. There is more mining activity at the present time in Colorado than in any other of the western states or territories.

Idaho has been engaged in mining operations since 1862 or 1863, at first in placers in Owyhee county, which yielded large sums from 1866 to 1872, and since 1867 in quartz mines also. In 1880 and 1881 new gold mines and placers were discovered at several points which promise a large production; but Idaho labors under three difficulties; much of its placer gold is what miners call flour gold—*i. e.*, of such impalpable fineness that it does not readily settle at the bottom of the riffles of the sluice and the quicksilver fails to take it up. It can only be saved as we have already explained by being allowed to run very slowly over iron sheets plated with silver and covered with the quicksilver, and even by this process not more than 50 per cent. is saved. A second difficulty is the very rugged character of the mountains and the lack of roads which make its mines almost inaccessible even by pack-mules, and the consequent lack of reduction works, so that, except in the case of ores which were extraordinarily rich, the cost of transportation and reduction was greater than their value. This is partly obviated now by the construction of some railways into the mining districts. A third difficulty is that Idaho is under Mormon control, and neither life nor property is safe.

Since 1862 Idaho has produced about $75,000,000 in gold, and is now yielding some silver.

Arizona has been known to be rich in gold, silver, and copper since 1857 or 1858, but owing to Indian raids and the ruffian outlaws who were its earliest inhabitants, life has been so unsafe there, till within the past three or four years, that its rich mines have been but slightly developed. A lack of timber and of water interferes to some extent with successful mining, but there is now a better condition of affairs, and its mining prospects are more encouraging. Silver is probably more plentiful than gold there, but there is enough of both. It is difficult to state with exactness the gold product since the mines were opened, but it must exceed $7,000,000, while the silver product is more than twice that sum.

Nevada has been generally known as a silver state, and has a pre-eminent claim to that title, having produced almost $350,000,000 of silver bullion since 1861 or 1862, and more than two-thirds of that sum since 1870, but its silver has been "alloyed" with gold, and some of its many mines have been of gold alone. Its state metallurgist claims, and on very high authority, that it has produced also over $100,000,000 of gold in the same time. It yielded about $3,000,000 in the fiscal year 1881.

Oregon is more an agricultural than a mining state, yet its gold mines since 1851 have yielded about $35,000,000, and are now producing more than a million a year. It has produced but little silver.

Utah, notwithstanding the many obstacles with which it has had to contend—its arid climate, its want of water and timber, and its Mormon government—has developed great mineral wealth, though more largely in silver than in gold. Its gold products thus far (and no mines of any importance were worked before 1869) have been probably not more than $1,800,000, while its yield of silver has exceeded $25,000,000, and is rapidly increasing.

New Mexico gives the promise of large production both of gold and silver; of the latter in greatest profusion, in the immediate future; while Washington, Wyoming, Alaska, and probably Texas and the Indian Territory are likely to develop as much mineral wealth as will be for their benefit, within the next decade.

The following table prepared with great care under the supervision of the Director of the Mint, gives the annual production of gold and silver in the United States for the fiscal years 1880 and 1881. Its figures are certainly not too high, but considerably below those of the state metallurgists who, however, give calendar instead of fiscal years.

The most important use of gold is as a medium of exchange. For this purpose it is converted into coin at the mints, and into bars or bullion at the government assay office. In this form a large portion of the receipts from California were formerly exported from New York to make up the balance of foreign trade. Each bar was stamped with marks, representing its fineness and weight, and may continue to be thus used, or when received at foreign mints, is converted into coin. The amount

| State or Territory. | Fiscal Year 1880. | | | Fiscal Year 1881. | | |
|---|---|---|---|---|---|---|
| | Gold. | Silver. | Total. | Gold. | Silver. | Total. |
| Alaska | $6,000 | ............ | $6,000 | $7,000 | ............ | $7,000 |
| Arizona | 400,000 | $2,000,000 | 2,400,000 | 770,000 | $7,800,000 | 8,570,000 |
| California | 17,500,000 | 1,100,000 | 18,600,000 | 19,000,000 | 870,000 | 19.870,000 |
| Colorado | 3,200,000 | 17,000,000 | 20,200,000 | 3,400,000 | 15,000,000 | 18,400,000 |
| Dakota | 3,600,000 | 70,000 | 3,670,000 | 4,500,000 | 60,000 | 4,560,000 |
| Georgia | 120,000 | ............ | 120,000 | 150,000 | ............ | 150,000 |
| Idaho | 1,980,000 | 450,000 | 2,430,000 | 1,930,000 | 1,100,000 | 3,030,000 |
| Montana | 2,400,000 | 2,500,000 | 4,900,000 | 2,500,000 | 2,300,000 | 4,800,000 |
| Nevada | 4,800,000 | 10,900,000 | 15,700,000 | 2,700,000 | 8,860,000 | 11,560,000 |
| New Mexico | 130,000 | 425,000 | 555,000 | 120,000 | 270,000 | 390,000 |
| North Carolina | 95,000 | ............ | 95,000 | 75,000 | ............ | 75,000 |
| Oregon | 1,090,000 | 15,000 | 1,105,000 | 1,000,000 | 80,000 | 1,080,000 |
| South Carolina | 15,000 | ............ | 15,000 | 18,000 | ............ | 18,000 |
| Tennessee | ............ | ............ | ............ | 2,000 | ............ | 2,000 |
| Utah | 210,000 | 4,740,000 | 4,950,000 | 200,000 | 5,710,000 | 5,910,000 |
| Virginia | 10,000 | ............ | 10,000 | 11,000 | ............ | 11,000 |
| Washington | 410,000 | ............ | 410,000 | 100,000 | ............ | 100,000 |
| Wyoming | 20,000 | ............ | 20,000 | 7,000 | ............ | 7,000 |
| Other | 14,000 | ............ | 14,000 | 10,000 | 50,000 | 60,000 |
| Total | $36,000,000 | $39,200,000 | $75,200,000 | $36,500,000 | $42,100,000 | $78,600,000 |

of gold coin in circulation, *i. e.*, in the Treasury, banks and private hands, November 1, 1881, was $468,493,227, and of silver, $181,070,624. A large amount of both gold and silver (over ten millions of gold and four millions of silver annually) are used in the repair or manufacture of instruments, chemicals, leaf and foil, pens, plates, spectacles, fine harness, electro-plating, watch cases, watches and jewelry, and the demand for these purposes is constantly increasing. The leaf and foil being worn out in the using, or being distributed in too small quantities together to pay for recovering them, are altogether lost to the community, after the articles have served the purpose intended. This loss in the time of James I. was considered so serious, that a special act was passed, restricting the use of gold and silver-leaf, except for specified objects, which, singularly enough, were chiefly for military accoutrements. Gold employed in the process of electro-plating, in which large quantities are consumed, is similarly lost in the using.

Besides the use of gold-leaf in gilding, it is employed quite largely by dentists as the best material for filling teeth. They also use some gold plate and wire for securing the artificial sets in the mouth. In book-binding, gold is consumed to considerable extent for lettering and ornamenting the backs of the books. The manufacture of gold-leaf is carried on in various places, both in the cities and country. It is a simple process, known in ancient times, but only of late years carried to a high degree of perfection. The ingots, molded for the purpose, and annealed in hot ashes, are rolled between rollers of polished steel, until the sheet is reduced from its original thickness of half an inch to a little more than $\frac{1}{800}$ of an inch, an ounce weight making a strip ten feet long and $1\frac{1}{2}$ inches wide. This is annealed and cut into pieces an inch square, each weighing about six grains. A pile is then made of 150 of these pieces, alternating with leaves of fine calf-skin vellum, each one of which is four inches square, and a number of extra leaves of the vellum are added at the top and bottom of the pile. The heap, called a tool or kutch, is slipped into a parchment case open at the two ends, and this into a similar one, so that each side of end they are made to diminish to half an inch thickness at the line across the middle. Each one is furnished with sides, and a strip across the thin end of six inches in height, the joining made perfectly tight, and is then swung between four posts in a horizontal position by four rods or chains, which should be at least eight feet long. Mercury is poured into the two divisions, until they are more than half filled. The sands are made to flow in upon the thin end, and are received upon the surface of the mercury; and the table is made to swing forward and back by the revolution of a crank. By the motion the sands are mixed in with the mercury, and swept along in successive waves, and falling over the middle ridge are treated in the same manner in the succeeding division. The mercury is retained by its weight in the depressed portions of the table, and the water and sands are discharged over the open end. Of the numerous machines designed for effecting the amalgamation of the gold patented within the last few years; few involve any new principles, but are merely modified forms of the old contrivances. Prof. A. K. Eaton, of New York, found that amalgamated metallic surfaces could be made to collect most completely the very fine particles of gold, which by all other processes it has been found impossible to secure. The use of copper, brass, or zinc proved troublesome and impracticable from the rapidity with which they were dissolved in the mercury, adulterating the amalgam. An amalgamated iron surface proved to be free from this objection, and the following description of apparatus was finally decided on as the most efficient: A circular plate of wrought iron is amalgamated over what is intended to be its inferior surface, and an open tube is fixed in its center, rising three or four feet high, and furnished at the top with a bowl or funnel. This tube and disk are supported upon a surface of mercury contained in a shallow tub of larger diameter than the disk, a frame-work being attached to the tub for this purpose. A pulley is fixed upon the hollow shaft, so that a belt may be attached for causing the disk to rotate upon the mercury. The sands are fed with water into the funnel at the top of the tube, and the pressure caused by the height of the column carries them down upon the mercurial surface, and, by reason of this pressure and the centrifugal action of the revolving disk, they gradually work outward between this surface and the amalgamated surface above, being pressed and rubbed between them till they escape round the circumference of the disk, and flow over the edge of the tub. Hot water, as in all other modes of amalgamating, is preferable to cold. By this process all free gold, however fine the particles, must come in contact with the amalgamated surface, and be taken up by the mercury. It perfectly separates the gold that in other machines floats off in the fine slime. In gold ores, especially those of sulphurous character, much of the gold is so fine that it remains suspended a long time in water, and is entirely lost. The important feature of this invention is the use of an inferior amalgamated surface, against which these floating particles are pressed. The pressure is secured by any desired depth of the mercury, but in practice less than an inch above the lower edge of the plate is found to be sufficient. The efficiency of the machine was fully tested in November, 1860, at the Gold Hill mine, in North Carolina, where good results were obtained with it. In the same month it was tried at the U. S. assay office, N. Y., upon the tailings of the sweeps from which all the gold had been extracted that could be removed by the amalgamating machines in use, and from these it readily separated the remaining portion.

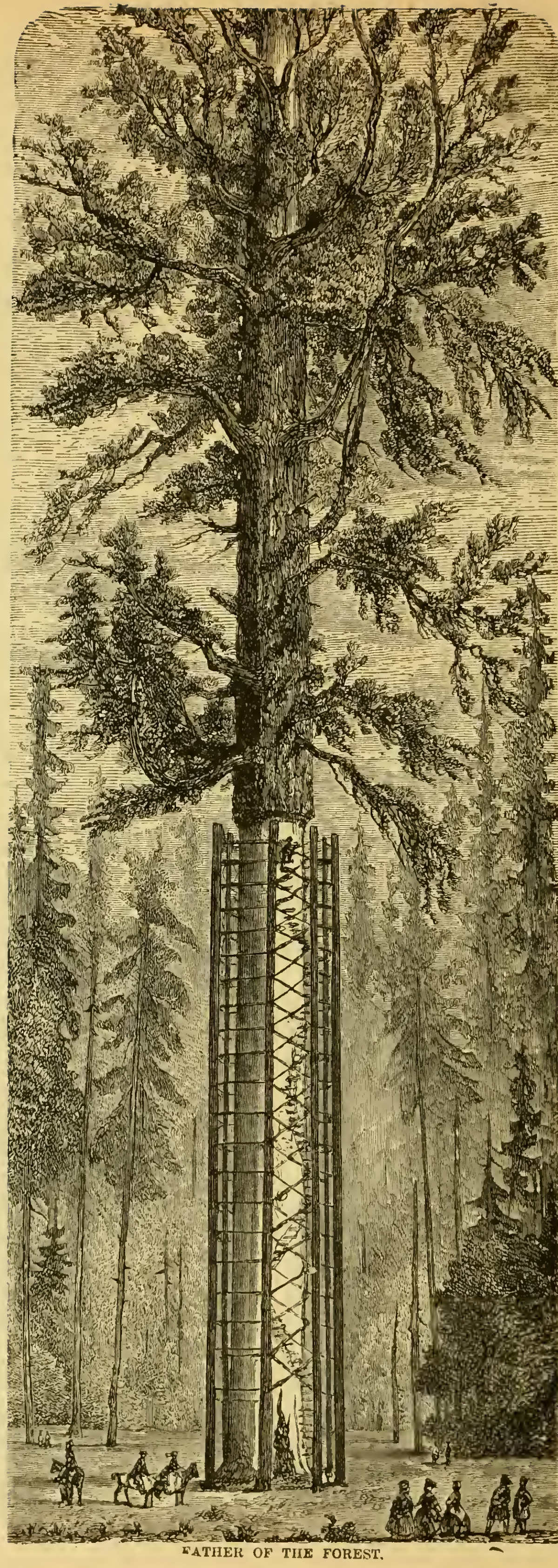
As remarked in the mention made of the Gold Hill mines, when gold is associated with iron and copper pyrites it is held very tenaciously, as if combined itself with the sulphur, like the other metals. However finely such ores are pulverized, every microscopic particle of pyrites appears to retain a portion of gold, and prevent its uniting with the mercury. This portion of the gold, consequently, escapes in the tailings; and if these are kept in refuse heaps, exposed to the weather, the pyrites slowly decompose, and more gold is continually set free. Thus it is the heaps may be washed over with profit for many successive years. Roasting of the ores is recommended by high authorities for freeing the gold at once, the effect of it being to break up the sulphurets, causing the sulphur to escape in vapor, and the iron to crumble down in the state of an oxide, or an ochreous powder, from which the gold is readily separated. This is objected to by others, who assert that it involves a great loss of gold, which is volatilized or carried off mechanically in the sulphur fumes. Two other methods adopted, since 1857, for the reduction of those ores containing large proportions of the sulphurets of iron and copper, deserve notice—viz., the "Sodium Amalgamating Process," and the "Plattner Chlorination Process."

The use of the Sodium in mechanical combination with mercury to oxidize and thus remove more readily the impurities, sulphur, arsenic, and antimony, which interfere with the reduction or extraction of gold from the quartz, was suggested about 1861, and has been made the subject of two patents, one by Dr. Chas. Wurtz in New York, in 1864, the other by Mr. Crookes, of London, in 1865. It has proved very successful in Colorado, Nova Scotia, and California, in those mines where the gold was so difficult of extraction, on account of the presence of a large percentage of refractory pyrites. The yield of gold from these ores has been increased from 20 to 30 per cent. The sodium is however as yet so costly, that it is only the richer ores in which it pays, commercially, to use it. Amalgams are now put up according to the formulæ of the patentees, containing the requisite quantity of sodium in combination with other metallic compounds. These are to be used, according to the amount of concentration, with from 20 to 150 times their weight of mercury. The Amalgam varies from $1.25 to $1.75 per pound. Recently it has been announced that cyanide of potassium was to be preferred for this purpose to sodium—while it is much cheaper. The Plattner chlorination process requires as a preliminary a double roasting of the ores, the first time at a low heat to oxidize the ore and burn out, as far as possible, the sulphurets and other impurities, and the second time, at a higher heat, to decompose the metallic salts formed at the first roasting. If sulphates of lime and magnesia are present they are removed by the addition of some common salt to the roasting mass. When the roasting is completed the ore is discharged from the furnace and allowed to cool, and then being damped is sifted into a large vat, lined with bitumen, and having a false bottom on which rests a filter composed of broken quartz and sand. The vat is provided with a close-fitting cover which can be luted on and made air-tight. The chlorine is then generated in a leaden vessel by means of sulphuric acid, and conducted into the bottom of the vat through a leaden pipe. As it passes up through the ore more ore is sifted in and the vat is gradually thoroughly charged with the gas, when the cover, having been luted on and all escape prevented, and the whole allowed to stand for twelve or eighteen hours the gold is completely chloridized. Water is then introduced which absorbs the chlorine and dissolves the chloride of gold, and a stream of water is permitted to run in at the top of the vat till the lixiviation is complete. The residue in the vat is then thrown away, and the solution of chloride of gold goes to the precipitating vat when a solution of proto-sulphate of iron is added to it, and it is permitted to stand for eight or ten hours. The water is then carefully drawn off, the precipitated gold collected upon a paper filter, dried, melted and run into bars. This gold will be, if the process is carefully conducted, 999 fine, or almost absolutely pure gold.

In the "branch mining" of the southern states, deposits worked by the rocker are regarded as profitable which pay a pennyweight or nearly one dollar per day to the hand employed. The great beds of decomposed slates of Georgia can be worked to profit when they yield from four to five cents worth of gold to the bushel of stuff, or about 100 lbs. weight; but the mill for crushing and washing it must then be close at hand. The proportion of the gold, in this case, is less than 2 parts in 1,000,000. The hard quartz ores must contain nearly or quite 20 cents worth of gold in the bushel, especially if they are pyritiferous.

Although the gold is obtained in a metallic state, it differs very much in value in different localities. Deposit gold from the vicinity of Dahlonega, in Georgia, is worth 93 cents the pennyweight; that of Hart county, in the same state, 98 cents; of Carroll county, Georgia, and Chesterfield district, South Carolina, $1.02; of Union county, Georgia, or the Tennessee line, 72 cents; Charlotte, North Carolina $1.00; and that of Burke county, North Carolina, only 50 cents. The average fineness of California gold is found to be from 875 to 885 parts in 1,000, which is very near that of our gold coin, viz, 900 in 1,000. The native gold from Australia has from 960 to 966 parts in 1,000 pure gold, and some from the Chaudiere, in Canada, 877.3 pure gold, and 122.3 silver; another specimen 892.4, silver 107.6. The specific gravity of the metal has been increased by casting from 14.6 in the native state to 17.48.

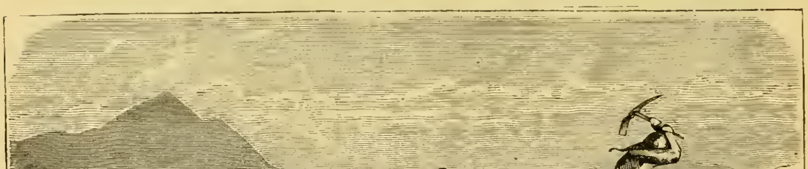
YOSEMITE VALLEY.



FATHER OF THE FOREST.

GOLD MINING IN CALIFORNIA.

PROSPECTER IN CALIFORNIA GOLD MINES.



CHINESE IN CALIFORNIA GOLD MINES.

## 1.—MINT OF THE UNITED STATES, PHILADELPHIA.

| Period. | Virginia. | North Carolina. | South Carolina. | Georgia. | Tennessee. | Alabama. | New Mexico. | California | Oregon. | Kansas. | Other sources. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1804 to 1827 . | .. | $110,000 00 | .. | .. | .. | .. | .. | .. | .. | .. | .. | $110,000 00 |
| 1828 to 1837.. | $427,000 00 | 2,519,500 00 | $327 500 | $1,763,900 00 | $12,400 | .. | .. | .. | .. | .. | $13,200 | 5,063,500 00 |
| 1838 to 1847.. | 518,294 00 | 1,303,636 00 | 152,366 | 566,316 00 | 16,499 | $45.493 | .. | .. | .. | .. | 21,037 | 2.623,641 00 |
| 1848......... | 57,886 00 | 109,034 00 | 19,228 | 3,370 00 | 3,497 | 3,670 | $682 | $44,177 00 | .. | .. | .. | 241,544 00 |
| 1849......... | 129,382 00 | 102,688 00 | 4,309 | 10,525 00 | 2,739 | 2,977 | 32,889 | 5,481,439 00 | .. | .. | 144 | 5,767,092 00 |
| 1850......... | 65,991 00 | 43,734 00 | 759 | 5,114 00 | 307 | 1,178 | 5,392 | 31,667,505 00 | .. | .. | 326 | 31,790,306 00 |
| 1851......... | 69,052 00 | 49,440 00 | 12,338 | 2,490 00 | 126 | 817 | 890 | 46,939,367 00 | .. | .. | .. | 47,074,520 00 |
| 1852......... | 83,626 00 | 65,248 00 | 4,505 | 3,420 00 | .. | 254 | 814 | 49.663,623 00 | .. | .. | .. | 49,821,490 00 |
| 1853......... | 52,200 00 | 45.690 00 | 3,522 | 1,912 00 | .. | .. | 3,632 | 52.732,227 00 | 13,535 | .. | 5,213 | 52,857,931 00 |
| 1854......... | 23,347 00 | 9,062 00 | 1,220 | 7.561 00 | .. | 245 | 738 | 35,671,185 00 | .. | .. | .. | 35,713,358 00 |
| 1855......... | 28,895 50 | 22,626 00 | 1,200 | 1,733 50 | .. | 310 | 900 | 2,634,297 63 | .. | .. | 1,535 | 2,691.497 63 |
| 1856......... | 21,607 00 | 12,910 00 | 5,980 | 4,910 00 | .. | .. | 2,460 | 1,440,134 58 | 40,750 | .. | .. | 1,528,751 58 |
| 1857......... | 2,505 00 | 6,805 00 | 2,565 | 3,542 00 | .. | .. | .. | 565,566 41 | .. | .. | .. | 580,983 41 |
| 1858......... | 18,377 00 | 15,175 00 | 300 | 18.365 00 | .. | .. | .. | 1,372,506 07 | 3,600 | .. | .. | 1,428,323 07 |
| 1859......... | 15,720 00 | 9,305 00 | 4,675 | 20,190 00 | 240 | .. | 275 | 959,191 79 | 2,960 | $145 | .. | 1,012,701 79 |
| Total....... | $1,513,882 50 | 4,424,853 00 | 540,467 | 2,413,348 50 | 35,808 | 54,944 | 48,672 | 229,171,219 48 | 60,845 | 145 | 41,455 | 238,305,639 48 |

## 2.—BRANCH MINT, SAN FRANCISCO.

| Period. | California. | Period. | California. | Period. | California. |
|---|---|---|---|---|---|
| 1854......................... | $10,842,281 23 | 1856........................... | 29,209,218 24 | 1858............................. | 19,104,369 99 |
| 1855.. ....................... | 20,860,437 20 | 1857........................... | 12,526,826 93 | 1859............. ............... | 14,098,564 14 |
| | | Total............................................................. | | | $106,641,697 73 |

## 3.—BRANCH MINT, NEW ORLEANS.

| Period. | North Caronna. | South Carolina. | Georgia. | Tennessee. | Alabama. | California. | Other sources. | Total. |
|---|---|---|---|---|---|---|---|---|
| 1838 to 1847................. | $741 | $14,306 | $37,364 | $1,772 00 | $61,903 | .. | $3,613 | $119,699 00 |
| 1848..................... | .. | 1,488 | 2,317 | 947 00 | 6,717 | $1,124 00 | .. | 12,593 00 |
| 1849..................... | .. | 423 | .. | .. | 4,062 | 669,921 00 | 2,733 | 677,189 00 |
| 1850..................... | .. | .. | .. | .. | 3,560 | 4,575,576 00 | 894 | 4,580,030 00 |
| 1851..................... | .. | .. | .. | .. | 1,040 | 8,764,682 00 | .. | 8,770.772 00 |
| 1852..................... | . | .. | .. | .. | .. | 3,777,784 00 | .. | 3,777,784 00 |
| 1853..................... | . | . | .. | .. | .. | 2,006,673 00 | .. | 2,006,673 00 |
| 1854..................... | .. | . | . | .. | .. | 981,511 00 | .. | 981,511 00 |
| 1855..................... | .. | .. | .. | .. | .. | 411,517 24 | .. | 411,517 24 |
| 1856..................... | .. | .. | .. | .. | .. | 283,344 91 | .. | 283,344 91 |
| 1857..................... | .. | .. | .. | .. | .. | 129,328 39 | .. | 129,328 39 |
| 1858..................... | .. | .. | 1,560 | 164 12 | .. | 448,439 84 | .. | 450,163 96 |
| 1859..................... | .. | .. | .. | .. | .. | 93,272 41 | .. | 93,272 41 |
| Total................ | $741 | 16,217 | 41,241 | 2,883 12 | 77,282 | 22,148,173 79 | 7,290 | 22,293,827 91 |

## 4. BRANCH MINT, CHARLOTTE, NORTH CAROLINA.

| Period. | N. Carolina. | S. Carolina. | California. | Total. |
|---|---|---|---|---|
| 1838 to 1847.... | $1,529,777 00 | $143,941 00 | .. | $1,673,718 00 |
| 1848.......... | 359,075 00 | 11,710 00 | .. | 370,785 00 |
| 1849.......... | 378,223 00 | 12,509 00 | .. | 390,732 00 |
| 1850.......... | 307,289 00 | 13,000 00 | .. | 320,289 00 |
| 1851.......... | 275,742 00 | 25,478 00 | $15,111 00 | 316,061 00 |
| 1852.......... | 337,604 00 | 64,934 00 | 28,362 00 | 430,900 00 |
| 1853.......... | 227,847 00 | 61,845 00 | 15,465 00 | 305,157 00 |
| 1854.......... | $188,277 00 | $19,006 00 | $6,328 00 | $213,606 00 |
| 1855.......... | 196,894 03 | 14,277 17 | 5,817 66 | 216,988 86 |
| 1856.......... | 157,355 18 | .. | 16,237 35 | 173,592 53 |
| 1857.......... | 170,560 33 | 5,807 16 | .. | 176,067 49 |
| 1858.......... | 75,376 47 | .. | .. | 75,376 47 |
| 1859.......... | 182,489 61 | 22,762 71 | .. | 205,252 32 |
| Total.......... | $4,386,239 62 | $394,965 04 | $87,321 01 | $4,868,525 67 |

## 5. BRANCH MINT, DAHLONEGA, GEORGIA.

| Period. | N. Carolina. | S. Carolina. | Georgia. | Tennessee. | Alabama. | California. | Kansas. | Other sources. | Total. |
|---|---|---|---|---|---|---|---|---|---|
| 1838 to 1847.. | $64,351 00 | $95,427 00 | $2,978,353 00 | $82,175 00 | $47,711 00 | .. | .. | .. | $3,218,017 00 |
| 1848.......... | 5,434 00 | 8,151 00 | 251,376 00 | 2,717 00 | 4,075 00 | .. | .. | .. | 271,753 00 |
| 1849.......... | 4,882 00 | 7,323 00 | 225,824 00 | 2,441 00 | 3,661 00 | .. | .. | .. | 244,131 00 |
| 1850.......... | 4,500 00 | 5,700 00 | 204,473 00 | 1,200 00 | 1,800 00 | $30,0 5 00 | .. | .. | 247,698 00 |
| 1851.......... | 1,971 00 | 3,236 00 | 154,723 00 | 2,251 00 | 2,105 00 | 214,072 00 | .. | $951 00 | 379,309 00 |
| 1852.......... | 443 00 | 57,543 00 | 93,122 00 | 750 00 | .. | 324,931 00 | .. | .. | 476,789 00 |
| 1853.......... | 2,085 00 | 33,950 00 | 56,984 00 | 149 00 | .. | 359,122 00 | .. | .. | 452,290 00 |
| 1854.......... | 5,818 00 | 15,988 00 | 47,027 00 | 223 00 | .. | 211,169 00 | .. | .. | 280,225 00 |
| 1855.......... | 3,145 82 | 9,113 27 | 56,686 36 | .. | 277 92 | 47,428 70 | .. | .. | 116,652 07 |
| 1856.......... | .. | 25,723 75 | 44,107 99 | 106 42 | .. | 81,467 10 | .. | .. | 101,405 26 |
| 1857.......... | .. | 8,083 89 | 25,097 63 | | .. | 6,498 42 | .. | .. | 39,679 54 |
| 1858.......... | .. | 32,322 28 | 57,891 45 | 107 33 | .. | 5,293 52 | .. | .. | 95,614 58 |
| 1859.......... | 2,656 83 | 4,310 35 | 57,023 12 | .. | .. | 699 19 | $82 70 | .. | 65,072 24 |
| Total.......... | $95,286 70 | $307,171 54 | $4,252,688 55 | $42,119 75 | $59,629 92 | $1,230,705 53 | $82 70 | $951 00 | $5,988,635 69 |

## 6. ASSAY OFFICE, NEW YORK.

| Period. | Virginia. | N. Carolina. | S. Carolina. | Georgia. | Alabama. | California. | Kansas. | Oregon. | Other sources. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1854.......... | $167 00 | $3,916 00 | $395 00 | $1,242 00 | .. | $9,221,457 00 | .. | .. | .. | $9,227,177 00 |
| 1855.......... | 2,370 00 | 3,750 00 | 7,620 00 | 13,100 00 | $350 00 | 25,025,896 11 | .. | .. | $1,600 00 | 25,054,686 11 |
| 1856.......... | 6,928 00 | 805 07 | 4,052 29 | 41,101 28 | 233 62 | 16,259,008 90 | .. | .. | .. | 16,582,129 16 |
| 1857.......... | 1,531 00 | 1,689 00 | 2,663 00 | 10,451 00 | 1,545 00 | 9,899,957 00 | .. | .. | .. | 9,917,836 00 |
| 1858.......... | 501 00 | 7,007 00 | 6,354 00 | 12,951 (0 | 2,181 00 | 19,660,551 46 | .. | $5,581 00 | 27,523 00 | 19,722,629 46 |
| 1859.......... | 436 00 | 20,122 00 | 700 00 | 14,756 00 | 593 00 | 11,694,872 25 | $3,944 00 | 2,866 00 | 405 00 | 11,738,694 25 |
| Total.......... | $11,933 00 | $37,289 07 | $21,784 29 | $93,601 28 | $4,902 62 | $92,031,722 72 | $3,944 00 | $8,447 00 | $29,528 00 | $92,243,151 98 |

## 7. SUMMARY EXHIBIT OF THE ENTIRE DEPOSITS OF DOMESTIC GOLD AT THE UNITED STATES MINT AND BRANCTES, TO JUNE 30, 1859.

| Mints. | Virginia. | N. Carolina. | S. Carolina. | Georgia. | Tennessee. | Alabama. | New Mexico. | California. | Kansas. | Oregon. | Other sources. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Philadelphia.... | $1,513,582 50 | $4,424,853 00 | $540,467 00 | $2,413,348 50 | $35,808 00 | $54,944 00 | $48,672 00 | $229,171,219 48 | $145 00 | $60,845 00 | $41,455 00 | $238,305,639 48 |
| San Francisco... | .. | .. | .. | .. | .. | .. | .. | 106,641,697 73 | .. | .. | .. | 106,640,697 73 |
| New Orleans.... | .. | 741 00 | 16 217 00 | 41,241 00 | 2,883 12 | 77,282 00 | .. | 22,148,173 79 | .. | .. | 7,290 00 | 22,293,827 91 |
| Charlotte...... | .. | 4,386,239 62 | 394,965 04 | .. | .. | .. | .. | 87,221 01 | .. | .. | .. | 4,868,525 67 |
| Dahlonega...... | .. | 95,286 70 | 307,171 54 | 4,252,688 55 | 42,119 75 | 59,629 92 | .. | 1,230,705 53 | 82 70 | .. | 951 00 | 5,988,635 69 |
| Assay Office..... | 11,933 00 | 37,289 07 | 21,784 29 | 93,601 28 | .. | 4,902 62 | .. | 92,031,722 72 | 3,944 00 | 8,447 00 | 29,528 00 | 92,243,151 98 |
| Total...... | $1,525,515 50 | $8,944,409 39 | $1,280,604 87 | $6,800,879 33 | $80,810 87 | $196,758 54 | $48,672 00 | $451,310,840 26 | $4,171 70 | $69,292 00 | $79,224 00 | $470,340,478 46 |

The most important use of gold is as a medium of exchange. For this purpose it is converted into coin at the mints, and into bars or bullion at the government assay office. In this form a large portion of the receipts from California is immediately exported from New York to make up the balance of foreign trade. Each bar is stamped with marks, representing its fineness and weight, and may continue to be thus used, or when received at foreign mints, is converted into coin. A large amount of gold is consumed in jewelry, trinkets, watches, and plate, and still more in the form of gold-leaf. This last being worn out in the using, or being distributed in too small quantities together to pay for recovering it, is altogether lost to the community, after the articles have served the purpose intended. This loss in the time of James I. was considered so serious, that a special act was passed, restricting the use of gold and silver-leaf, except for specified objects, which, singularly enough, were chiefly for military accoutrements. Gold employed in the recently invented process of electrotyping, in which large quantities are consumed, is similarly lost in the using.

Besides the use of gold-leaf in gilding, it is employed quite largely by dentists as the best material for filling teeth. They also use much gold plate and wire for securing the artificial sets in the mouth. In bookbinding, gold is consumed to considerable extent for lettering and ornamenting the backs of the books. The manufacture of gold-leaf is carried on in various places, both in the cities and country. It is a simple process, known in ancient times, but only of late years carried to a high degree of perfection. The ingots, moulded for the purpose, and annealed in hot ashes, are rolled between rollers of polished steel, until the sheet is reduced from its original thickness of half an inch to a little more than $\frac{1}{800}$ of an inch, an ounce weight making a strip ten feet long and $1\frac{1}{2}$ inches wide. This is annealed and cut into pieces an inch square, each weighing about six grains. A pile is then made of 150 of these pieces, alternating with leaves of fine calf-skin vellum, each one of which is four inches square, and a number of extra leaves of the vellum are added at the top and bottom of the pile. The heap, called a tool or kutch, is slipped into a parchment case open at the two ends, and this into a similar one, so that each side of the pack is protected by one of the case. It is placed upon a block of marble, and then beaten with a hammer weighing sixteen pounds, and furnished with a convex face, the effect of which is to cause the gold to spread more rapidly. The workman wields this with great dexterity, shifting it from one hand to the other, without interfering with the regularity of the blow. The pack is occasionally turned over, and is bent and rolled in the hands to cause the gold to extend freely between the leaves, as it is expanded. The gold-leaves are also interchanged to expose them all equally to the beating. When they have attained the full size of the vellum, which is done in about twenty minutes, they are taken apart, and cut each one into four pieces, making 600 of the original 150. These are packed in gold-beater's skin, and the pack is beaten as before, but with a lighter hammer, until they are extended again to sixteen square inches. This occupies about two hours. The gold-leaves are then taken out, and spread singly upon a leather cushion, where they are cut into four squares by two sharp edges of cane, arranged in the form of a cross. To any other kind of a knife the gold would adhere. These leaves are again packed, 800 together, in the finest kind of gold-beater's skin, and expanded till each leaf is from 3 to $3\frac{1}{2}$ inches square. The aggregate surface is about 192 times larger than that of the original sheet, and the thickness is reduced to about the $\frac{1}{150000}$ of an inch. The beating is sometimes carried further than this, especially by the French, so that an ounce of gold is extended over 160 square feet, and its thickness is reduced to $\frac{1}{234000}$ of an inch, or even to $\frac{1}{250000}$. When the pack is opened, the leaves are carefully lifted by a pair of wooden pliers, spread upon a leather cushion by the aid of the breath, and cut into four squares of about $3\frac{1}{4}$ inches each, which are immediately transferred one by one between the leaves of a little book of smooth paper, which are prevented from adhering to the gold-leaves by an application of red ochre or red chalk. Twenty-five leaves are put into each book, and when filled, it is pressed hard, and all projecting edges of the gold are wiped away with a bit of linen. The books are then put up in packages of a dozen together for sale.

An imitation gold-leaf, called Dutch gold-leaf, is used to some extent. It is prepared from sheets of brass, which are gilded, and beaten down in the manner already described. When new it appears like genuine gold-leaf, but soon becomes tarnished in use. Party gold-leaf is formed of leaves of gold and of silver, laid together and made to unite by beating and hammering. It is then beaten down like gold-leaf.

The gold-beater's skin used in this manufacture is a peculiar preparation made from the cæcum of the ox. The membrane is doubled together, the two mucous surfaces face to face, in which state they unite firmly. It is then treated with preparations of alum, isinglass, whites of eggs, etc., sometimes with creosote, and after being beaten between folds of paper to expel the grease, is pressed and dried. In this way leaves are obtained $5\frac{1}{8}$ inches square, of which books are made up, containing 850 leaves. After being used for a considerable time, the leaves become dry and stiff, so that the gold cannot spread freely between them. To remedy this, they are moistened with wine or with vinegar and water, laid between parchment, and thoroughly beaten. They are then dusted over with calcined selenite, or gypsum, reduced to a fine powder. The vellum, which is used before the gold-beater's skin, is selected from the finest varieties, and this, too, after being well washed and dried under a press, is brushed over with pulverized gypsum.

In the great exhibition at London in 1851, machines were exhibited from the United States, and also from Paris, which were designed for gold-beating. After repeated trials, both in Europe and America, these machines have been abandoned, and the gold-beaters have returned to the old method.

## CHAPTER IV.

### LEAD.

Lead is met with in a great number of combinations, and has also been found in small quantity, at a few localities in Europe, in a native state. The ore from which the greater part of the lead of commerce is obtained, is the sulphuret, called galena, a combination of 86.55 per cent. of lead and 13.45 of sulphur. It is a steel-gray mineral of brilliant metallic luster when freshly broken, and is often obtained in large cubical crystals; the fragments of these are all in cubical forms. The ore is also sometimes in masses of granular structure. Very frequently galena contains silver in the form of sulphuret of that metal, and gold is often found in combination with it. The quantity of silver is estimated by the number of ounces to the ton, and this may amount to 100 or 200, or even more; but when lead contains three ounces of silver to the ton this may be profitably separated. Ores of this character are known as argentiferous galena; if the silver is more valuable than the lead they are more properly called silver ores. Galena is easily melted, and in contact with charcoal the sulphur is expelled and the lead obtained. The ore is found in veins in rocks of different geological formations, as in the metamorphic rocks of New England, the lower silurian rocks of Iowa, Wisconsin, and Missouri, in limestones and sandstones of later age in New York and Pennsylvania, belonging to higher groups of the Appalachian system of rocks, and in some of the silver-producing ores of the far west.

Carbonate of lead is another of the lead ores which often contains much silver. It is of light color, whitish or grayish, commonly crystallized, and in an impure form is sometimes obtained in an earthy powder. It abounds in Lake Co., Colorado, forming the sole ore of the Leadville region and is found in other counties of that State, and in Nevada, Utah, California, and probably in Idaho and Dakota. At St. Lawrence Co., N. Y., large quantities of it have been collected for smelting, and were called lead ashes. The ore may escape notice from its unmetallic appearance, and at the Missouri mines large quantities were formerly thrown aside as worthless. It contains 77.5 per cent. of lead combined with 6 per cent. of oxygen, and this compound with 16.5 per cent. of carbonic acid. Beautiful crystals of the ore, some transparent, have been obtained at the mines on the Schuylkill, near Phœnixville, Pennsylvania; the Washington mine, Davidson county, North Carolina; and Mine la Motte, Missouri.

Another ore, the phosphate or pyromorphite, has been known only as a rare mineral until it was produced at the Phœnixville mines so abundantly as to constitute much the larger portion of the ores smelted. It is obtained in masses of small crystals of a green color, and sometimes of other shades, as yellow, orange, brown, etc., derived from the minute portions of chrome in combination. With these a variety of other compounds of lead are mixed, together with phosphate of lime and fluoride of calcium, so that the percentage of the metal is variable. The compounds of lead met with at these mines are the sulphuret, sulphate, carbonate, phosphate, arseniate, molybdate, chromate, chromo-molybdate, arsenio-phosphate, and antimonial argentiferous. Besides all these, a single vein contained native silver, native copper, and native sulphur, three compounds of zinc, four of copper, four of iron, black oxide of manganese, sulphate of barytes, and quartz.

For many years large quantities of lead were imported into the United States from Spain and Great Britain, and as lately as 1872 these importations amounted to $3,322,000, but they have now almost entirely ceased, amounting to only $62,000 in 1879, and $32,600 in 1880, and in both years being balanced by our exports. The lead produced in Nevada, Michigan, Iowa, Wisconsin, Missouri, Colorado, and the other silver states fully supplies our markets The lead ores in the eastern states are not of much importance. In Maine the ores are found in Cobscook Bay, near Lubec and Eastport, in limestone rocks near dikes of trap. A mine was opened in 1832, and a drift was carried in about 155 feet at the base of a rocky cliff on the course of the vein; it was then abandoned, but operations have recently been recommenced. In New Hampshire argentiferous galena is found in numerous places, but always in too small quantity to pay the expenses of extraction. At Shelburne a large quartz vein was worked from 1846 to 1849, and three shafts were sunk, one of them 275 feet in depth. The ore was found in bunches and narrow streaks, but in small quantity. Some of it was smelted on the spot, and five tons were shipped to England, which sold for £16 per ton. The richest yielded 84 ounces of silver to the ton. Another vein of argentiferous galena was partially explored at Eaton in 1856.

Massachusetts, also, contains a number of lead veins, none of which have proved profitable. The most noted are those of Southampton and Easthampton. Operations were commenced at the former place in 1765 upon a great lode of quartz containing galena, blende, copper pyrites, and sulphate of barytes It is in a coarse granitic rock near its contact with the red sandstone of the Connecticut valley. About the year 1810 an adit level was boldly laid out to be driven in from 1,100 to 1,200 feet, to intersect the vein at 140 feet below the surface. A single miner is said to have worked at it till his death, in 1828, when it had reached the length of 900 feet. At different times this adit has been pushed on, and when last abandoned, in 1854, it was supposed to be within a few feet of the vein. The rock was so excessively hard that the cost of driving the adit was about $25 per foot. Lead veins are found in Whately, Hatfield, and other towns in Hampshire county.

In Connecticut, also, several veins have been worked to some extent. That at Middletown, referred to in the introductory remarks as one of the earliest opened mines in the United States, is the most noticeable. It is unknown when this mine was first worked. In 1852 operations were renewed upon it, and a shaft sunk 120 feet below the old workings. The vein was among strata of a silicious slate, in some places quite rich. but on the whole it proved too poor to work. The ore contained silver to the value of from $25 to $75 to the ton of lead.

Lead mines have been opened in New York, in Dutchess, Columbia, Washington, Rensselaer, Ulster, and St. Lawrence counties. In the first four of these the ore is found in veins near the junction of the metamorphic slates and limestones. The Ancram or Livingston mine, in Columbia county, was worked at different times at considerable expense, but with no returns. A mine in Northeast, Dutchess county, was first opened by some German miners in 1740, and ore from it was exported. The Committee of Public Safety, during the revolutionary war, sought to obtain supplies of lead from it. The lead veins of this part of New York attracted more interest, on account of their highly argentiferous character, than the quantity of ore they yielded would justify; but it seems to be almost universally the case throughout the eastern United States that the galena yielding much silver fails in quantity. The Ulster county mines are found on the west side of the Shawangunk mountain in the strata of hard grit rock which cover its western slope. At different places along this ridge veins have been found cutting across the strata in nearly vertical lines, and have produced some lead, zinc, and copper. The Montgomery mine, near Wurtsboro, in Sullivan county, was chiefly productive in zinc. Near Ellenville, Ulster county, several veins have been followed into the mountain, and one of these, which was worked in 1853, afforded for a short time considerable quantities of rich lead and copper ores. From the former there were smelted about 459,000 pounds of lead, and the sales of the latter amounted to from 60 to 70 tons, of which 50 tons yielded 24.3 per cent. of copper. Where the vein was productive it contained the rich ores unmixed with stony gangues, and sometimes presenting a thickness of five feet of pure ore; where it became poor it closed in sometimes to a mere crack in the grit rock, and then the expense of extending the workings became very great from the extreme hardness of this rock. The expense of working in the hard rock proved to be too great for the amount of ore obtained, and the mine was abandoned in 1854, although its production, for the extent of ground opened, has been exceeded by but few other mines in the eastern states. The most promising veins in the state are those of St. Lawrence county in the vicinity of Rossie. They occur in gneiss rock, which they cut in nearly vertical lines. One of these was opened along the summit of Coal Hill, in 1837 and 1838, but was abandoned, in 1839, after the company had realized about $241,000 by the sale of some 1,800 tons of lead they had extracted. A nearly transparent crystal of calcareous spar from this vein, weighing 165 lbs., is preserved in the cabinet of Yale College.

In Pennsylvania the most productive lead mines were those of Montgomery and Chester counties, found in a small district of 5 or 6 miles in length by 2 or 3 in width, at the line of contact of the gneiss and red shale and sandstone. About 12 parallel veins have been discovered, extending north 32° to 35° east, and dipping steeply southeast. In the gneiss they are productive in lead ores, and in the red shale in copper. The gneiss is decomposed, and the vein itself is in considerable part ochreous and earthy, owing to decomposition of pyritous ores. In this material, called by the miners gossan, silver has been discovered amounting to 10 ounces to the ton. The two principal mines of this group are the Wheatley and the Chester County. Both yielded a considerable quantity of 60 per cent. ore, principally phosphate, though containing some galena, the latter yielded also from 1.6 to 16.2 oz. of silver to the ton. Both were abandoned in 1854.

Lead ores are found along the Blue Ridge, in Virginia, and at one point, near the central portion of its range across the state, a mine has been worked for a number of years. They are also met with in several of the gold mines, but not in workable quantities. In south-west Virginia and east Tennessee the ores are found in the silurian limestones, and a considerable number of mines have been worked to a moderate extent in both states. The only one now worked is the Wythe lead mine, sixteen miles from Wytheville, which was opened in 1754. It is in a steep hill on the border of New River, a fall upon which, near the mine, affords power for raising the water required in dressing the ores, and also for producing the blast for the furnace. Several shafts have been sunk, one of which extending down to the adit—a depth of 225 feet—is used as a shot tower. The ores are galena, with more or less carbonates intermixed. The product for 1870 is stated to have been 242 tons of lead, worth $43,720.

South of Virginia the only lead mine of importance is the Washington mine, Davidson county, North Carolina. This was opened in 1836, in the silicious and talcose slates of the gold region, and was worked for the carbonate of lead, which was found in a dull, heavy ore of earthy appearance, with which were intermixed glassy crystals of the same mineral. Some galena and phosphate of lead were also met with. After a time native silver was detected, and the lead that had been obtained was found to be rich in silver. Till 1844 the mine continued to produce ores containing much silver, and afforded the first deposits of this metal in the mint from domestic mines. The character of the ores changed, however, below the depth of 125 feet, the silver almost disappearing. The actual product of the mine is not known. That of 1844 is said to have been $24.209 in value of silver, and $7,253 of gold, obtained from 160,000 pounds of lead—an average of 240 ounces of auriferous silver to 2,000 pounds of metal. In 1851 the

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production was 56,896 pounds of lead and 7,942.16 ounces of auriferous silver—equal to 279 ounces to the ton of metal. Zinc blende and galena became after a time the prevailing ores, the silver varying from 2.5 to 195 ounces to the ton; and at last the zinc blende alone remained. In 1870 this yielded $522,000 of pure zinc.

The most productive lead mines in the United States are those of Nevada. The galena ores there are almost all argentiferous, and beside their abundant yield of silver, produced in 1870 lead to the amount of more than a million of dollars, and in 1879 two of its three lead districts, Eureka, Lander, and Pine Co.'s, produced more lead than those of Missouri, Iowa, and Illinois combined. The next state in the amount of its production is Missouri, or perhaps we should rather say that entire lead district in which are included the upper mines near the Mississippi, in Iowa, southwestern Wisconsin, and northwestern Illinois, and the lower mines in Missouri. The consumption of lead in the United States in 1870 was about 45,000 tons, and its value about $7,000,000. The consumption of 1880 is nearly or quite 56,000 tons, and its value, owing to the reduction of price, is about $8,000,000. Of the consumption in 1870, just about one-half was imported; in 1880 none was imported, or only an amount no larger than that exported. Of the $8,000,000 in value, Nevada produces about $3,000,000, and the Mississippi river district named above about the same. Colorado produces very nearly a million dollars' worth, and the remainder is divided between the other silver states, and Kansas, Arkansas, and the region east of the Mississippi.

But to return to the Mississippi river district. The existence of lead ores in the upper district, Iowa, Wisconsin, and Illinois, was made known by Le Sueur, who discovered them in his voyage up the Mississippi in 1700–1701. They attracted no further attention, however, till a French miner, Julien Dubuque, commenced to work them in 1788; and in this employment he continued, on the spot where now stands the city in Iowa bearing his name, until his death in 1809. When the United States acquired possession of the country in 1807, the mineral lands were reserved from the sales, and leases of mining rights were authorized. These were not, however, issued until 1822, and little mining was done before 1826. From that time the production of lead rapidly increased; and the government for a time received the regular rates for the leases. But after 1834 the miners and smelters refused to pay them any longer, on account of so many sales having been made and patents granted of mineral lands in Wisconsin. In 1839 the United States government authorized a geological survey of the lead region, in order to designate precisely the mineral tracts, and this was accomplished the same year by Dr. D. D. Owen, with the aid of 139 assistants. In 1844 it was decided to abandon the leasing system, and throw all the lands into the market. The lead region, according to the report of Dr. Owen, extends over about 62 townships in Wisconsin, 10 in the north-west corner of Illinois, and 8 in Iowa—a territory altogether of about 2,880 square miles. Its western limit is about 12 miles from the Mississippi river; to the north it extends nearly to Wisconsin river; south to Apple river, in Illinois; and east to the east branch of the Pekatonica. From east to west it is 87 miles across, and from north to south 54 miles. Much of the region is a rolling prairie, with a few isolated hills, called mounds, scattered upon its surface, the highest of them rising scarcely more than 200 feet above the general level. The prevailing limestone formations give fertility to the soil, and the country is well watered by numerous small streams, which flow in valleys excavated from 100 to 150 feet below the higher levels. The limestone, of gray and yellowish gray colors, lies in nearly horizontal strata, and the portion which contains the lead veins hardly exceeds 50 feet in thickness. Beneath it is a sandstone of the age of the Potsdam sandstone, and above it are strata of limestone recognized as belonging to the Trenton limestone, so that it proves to be a formation interposed between these, quite western in character, as it is not met with east of Wisconsin. The veins occupy straight vertical fissures, and several near together sometimes extend nearly a mile in an east and west direction. They never reach downward into the sandstone, but are lost in the lower strata of the limestone, and where the upper strata of the formation appear, these cover over the veins, and are consequently known as the cap-rock. In the fissures or crevices the galena is found, sometimes in loose sheets and lumps embedded in clay and earthy oxide of iron, and sometimes attached to one or both walls. It is rarely so much as a foot thick. No other ores are found with it, except some zinc blende and calamine, and occasionally pyritous iron and copper. The lead contains but a trace of silver. The fissures, as they are followed beneath the surface, sometimes expand in width till they form what is called an "opening;" and the hollow space may go on enlarging till it becomes a cave of several hundred feet in length and 30 or 40 in width. Their dimensions are, however, usually within 40 or 50 feet in length, 4 to 8 in width, and as many in height. The walls of the openings often afford a thick incrustation of galena, besides more or less loose mineral in the clay, among the fragments of rock, with all of which the caves are partially filled. Flat sheets of ore often extend from the vertical fissures between the horizontal limestone strata; these are more apt to contain blende, and pyrites, and calcareous spar than the ore of the vertical crevices. Besides these modes of occurrence, galena is found in loose lumps in the clayey loam of the prairies. This is called float mineral, and is regarded as an evidence of productive fissures in the vicinity.

The galena occurs under a variety of singular forms in the crevices. It lines curious cavities which extend up in the cap-rock, terminating above in a point, and which are known as chimneys. Upon the roofs of the openings it is found in large bunches of cubical crystals, and the same are obtained lying in the clays of the same openings. A flat sheet of the ore was worked in Iowa that was more than 20 feet across and from 2 to 3 feet thick, each side of which turned down in a vertical sheet, gradually diminishing in thickness. It yielded 1,200,000 lbs. of rich galena, and more still remained behind in sight. The crevices near Dubuque are the most regular and productive of any in the district. One called the Langworthy, on a length of about three-fourths of a mile, has produced 10,000,000 lbs. of ore. On the main fissure there were usually three ranges of crevices one above another, widening out to 15 or 20 feet.

The smelters of this region form a distinct class from the miners, of whom the former buy the ores as these are raised, and convert them into metal in the little smelting establishments scattered through the country. The lead has been principally sent down the Mississippi river to Saint Louis and New Orleans; but a portion has always been consumed in the country, and some has been wagoned across to Milwaukee before the construction of railroads, which since 1853 have afforded increased facilities for distributing in different directions the product of the mines. The only records of the amount of lead obtained are those of the shipments down the river. The following table presents the number of pigs shipped from the earlier workings to 1879; the figures for 1841 to 1850, inclusive, being furnished to Dr. Owen's Report of 1852 by Mr. James Carter, of Galena. The pigs weigh about 80 pounds each.

SHIPMENTS OF LEAD FROM THE UPPER MISSISSIPPI.

| Years. | Pigs. | Years. | Pigs. |
|---|---|---|---|
| 1821 to 1823 | 4,790 | 1857 | 485,475 |
| 1824 | 2,503 | 1863 | 79,823 |
| 1825 | 9,490 | 1864 | 93,035 |
| 1827 | 74,130 | 1865 | 116,636 |
| 1829 | 190,620 | 1866 | 149,584 |
| 1831 | 91,170 | 1867 | 144,555 |
| 1833 | 113,440 | 1868 | 185.823 |
| 1835 | 158,330 | 1869 | 228,303 |
| 1837 | 219,360 | 1870 | 237,939 |
| 1839 | 357,785 | 1871 | 229,796 |
| 1841 | 452,814 | 1872 | 285,769 |
| 1843 | 561,321 | 1873 | 356.037 |
| 1845 | 778.460 | 1874 | 479.448 |
| 1847 | 771,679 | 1875 | 579,202 |
| 1849 | 628,934 | 1876 | 665,557 |
| 1851 | 474,115 | 1877 | 790,028 |
| 1853 | 425,814 | 1878 | 754.357 |
| 1855 | 430,365 | 1879 | 817,594 |

The lead region of Missouri was first brought into public notice by the explorations of the French adventurer, Renault, who was sent out from Paris in 1720, with a party of miners, to search for precious metals in the territory of Louisiana, under a patent granted by the French government to the famous company of John Law. Their investigations were carried on in the region lying near the Mississippi and south of the Missouri river; and here, though they failed to find the precious metals they were in search of, they discovered and opened many mines of lead ore. A large mining tract in the northern part of Madison county is still called by the name of their mineralogist, La Motte. Their operations, however, were altogether superficial, and the lead they obtained was wholly by the rude and wasteful process of smelting the ores upon open log-heaps—a practice which even of late years is followed to some extent. Up to Renault's return to France, in 1742, little progress had been made in the development of this mining district. The next step was made by one Moses Austin, of Virginia, who obtained from the Spanish government a grant of land near Potosi, and commenced in 1798 regular mining operations by sinking a shaft. He also started a reverberatory furnace and built a shot tower. Schoolcraft states in his "View of the Lead Mines of Missouri," that there were in 1819 forty-five mines in operation, giving employment to 1,100 persons. Mine á Burton and the Potosi diggings had produced from 1798 to 1816 an annual average amount exceeding 500,000 pounds; and in 1811 the production of Mine Shibboleth was 3,125,000 pounds of lead from 5,000,000 pounds of ore. At a later period, from 1834 to 1837, the several mines of the La Motte tract produced, it is estimated, 1,035,820 pounds of lead per annum. From 1840 to 1854 the total yield of all the mines is stated by Dr. Litton in the state geological report to amount to over 3,833,121 pounds annually. At the close of this period it had, however, greatly fallen off, there being at that time scarcely 200 persons engaged in mining, besides those employed at the three mines known as Perry's, Vallé's, and Skewers'. Lead has been found in 41 counties of Missouri, though not fully worked in half that number. The ores are found in strata of magnesian limestone of an older date than the galena limestone of Wisconsin, and supposed to lie, with the sandstones with which they alternate, on the same geological horizon as the calciferous sand rock, which is found in the eastern states overlying the Potsdam sandstone. Some of the mines are at the contact of the horizontal limestone with granite rocks, but the ores in this position are only in superficial deposits or in layers included in the limestone. In their general features the veins do not differ greatly from those of the northern mines. Some of them, however, contain a larger proportion of other ores besides galena, as well as a greater variety of them. Carbonate of lead, called by the Miners dry bone and white mineral, is more abundant, and also blende, called by them black jack, and the silicate of zinc. Iron and copper pyrites are often seen, and at Mine la Motte are found the black oxides of cobalt and manganese associated with the carbonates of lead and copper. Nearly all the mining operations have been mere superficial excavations in the clay, which were soon exhausted of the loose ore and abandoned. But to this there are some remarkable exceptions of deeper and more permanent mines than are known in the northern lead regions. Such are Vallé's and Perry's mines, both situated on the same group of veins, which form a network of fissures and openings running in every direction and spreading over an area of about 1,500 feet in length by 500 in breadth, the extension of which is from northwest to south-east. These mines have been steadily worked since 1824, and 22 shafts have been sunk upon the fissures, six of which are over 110 feet deep, one is 170 feet deep, and only two are less than 50 feet. For the first 10 to 30 feet they pass through gravel and clay, below this through a silicious magnesian limestone of light color, and then enter a very close-grained variety of the same, called by the miners the cast steel rock. A succession of openings are encountered, which are distributed with considerable regularity upon three different levels. Those of the middle series have been the most productive. Sometimes chimneys connect them with the caves of the tier above or below. The portion of these mines on the Vallé tract produced, according to the state report, from 1824 to 1834 about 10,000,000 pounds of lead, and in the succeeding 20 years about as much more; and Perry's mine from 1839 to 1854 has produced about 18,000,000 pounds.

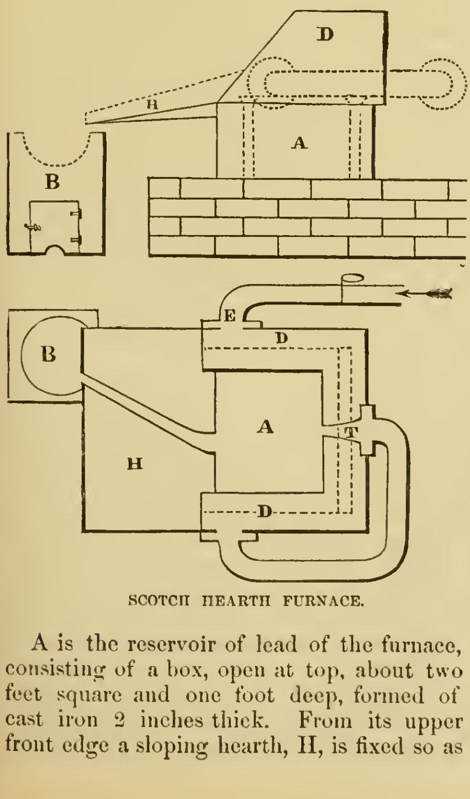
No accurate estimates have been preserved of the total production of the Missouri mines. For many years it fell short of the yield of the northern mines. From 1832 to 1843 it is reported as running from 2,500 to 3,700 tons per annum, while that of the northern mines in the same time was from 5,500 to 14,000 tons, and in 1845 it even exceeded 24,000 tons. In 1852 Mr. J. D. Whitney estimated that the production in Missouri had fallen to 1,500 tons, or less; but since 1865 it has materially advanced. The report of receipts and shipments on the preceding page represents since 1863 mainly the production of the

| Years. | Pig lead from American mines received at St. Louis and New Orleans. lbs. | Pig, bar, and sheet lead imported. lbs. | Invoice value of yearly importations. | Average rate of duty per 100 lbs. | White and red lead imported lbs. | Invoice value of yearly importations. |
|---|---|---|---|---|---|---|
| 1832...... | 8,540,000 | 5,333,588 | $124,311 | $3.00 | 557,781 | $30,791 |
| 1833...... | 12,600,000 | 2,282,068 | 60,660 | 3.00 | 625,069 | 36,049 |
| 1834...... | 14,140,000 | 4,997,293 | 168,811 | 2.77 | 1,024,663 | 57,572 |
| 1835...... | 16,000,000 | 1,006,472 | 35,663 | 2.77 | 832,215 | 50,225 |
| 1836...... | 18,000,000 | 919,087 | 35,283 | 2.55 | 908,105 | 62,237 |
| 1837...... | 20,000,000 | 335,772 | 13,871 | 2.57 | 599,980 | 47,316 |
| 1838...... | 20,860,000 | 165,844 | 6,573 | 2.34 | 522,681 | 38,683 |
| 1839...... | 24,000,000 | 528,922 | 18,631 | 2.31 | 720,408 | 50,905 |
| 1840...... | 27,000,000 | 519,343 | 18,111 | 2.08 | 643,418 | 41,043 |
| 1841...... | 30,000,000 | 62,246 | 2,605 | 2.07 | 532,122 | 31,617 |
| 1842...... | 33,110,000 | 4,689 | 155 | 3.00 | 479,738 | 28,747 |
| 1843...... | 39,970,000 | 290 | 3 | 3.00 | 93,166 | 5,600 |
| 1844...... | 44,730,000 | .. | .. | 3.00 | .. | .. |
| 1845...... | 51,240,000 | 19,609 | 458 | 3.00 | 231,171 | 14,744 |
| 1846...... | 54,950,000 | 214 | 6 | 3.00 | 215,434 | 15,685 |
| 1847...... | 46,130,000 | 224,905 | 6,288 | 0.56 | 298,387 | 15,228 |
| 1848...... | 42,420,000 | 2,684,700 | 85,387 | 0.64 | 318,781 | 19,703 |
| 1849...... | 35,560,000 | .. | .. | .. | .. | .. |
| 1850...... | 40,313,910 | 36,997,751 | 1,182,597 | 0.64 | 853,463 | 43,756 |
| 1851...... | 34,934,480 | 43,470,210 | 1,517,603 | 0.70 | 1,105,852 | 52,631 |
| 1852...... | 28,593,180 | 37,544,588 | 1,283,331 | 0.70 | 842,521 | 43,365 |
| 1853...... | 31,497,950 | 43,174,447 | 1,618,058 | 0.70 | 1,224,068 | 69,058 |
| 1854...... | 21,472,990 | 47,714,140 | 2,095,039 | 0.90 | 1,865,893 | 102,812 |
| 1855...... | 21,441,140 | 56,745,247 | 2,556,523 | 0.90 | 2,319,099 | 134,855 |
| 1856...... | 15,347,880 | 55,294,256 | 2,528,014 | 0.91 | 3,548,409 | 174,125 |
| 1857...... | 14,028,140 | 47,947,698 | 2,305,768 | 0.72 | 1,793,377 | 113,075 |
| 1858...... | 21,210,420 | 41,230,019 | 1,972,243 | 0.72 | 1,785,851 | 109,426 |
| 1859...... | 23,442,870 | 64,000,000 | 2,617,770 | 0.72 | 61,936 | 3,871 |
| 1860...... | 22,683,125 | 45,896,700 | 1,835,868 | 0.72 | 177,744 | 11,109 |
| 1861...... | 21,554,743 | 45,654,100 | 1,826,164 | 0.72 | 200,848 | 12,553 |
| 1862...... | 20,370,188 | 34,611,575 | 1,384,463 | 0.78 | 307,824 | 19,239 |
| 1863...... | 22,798,142 | 39,437,566 | 2,816,969 | 1.11 | 1,004,624 | 71,766 |
| 1864...... | 18,141,878 | 20,897,109 | 2,247,001 | 1.32 | 1,390,052 | 149,468 |
| 1865...... | 18,266,313 | 7,969,080 | 1,195,362 | 1.75 | 1,662,516 | 249,385 |
| 1866...... | 23,393,450 | 40,223,888 | 2,513,993 | 2.25 | 2,035,395 | 135,693 |
| 1867...... | 26,301,357 | 41,063,175 | 2,737,745 | 0.96 | 1,464,972 | 122,081 |
| 1868...... | 30,014,759 | 41,437,520 | 2,762,520 | 1.00 | 1,399,512 | 116,626 |
| 1869...... | 33,717,830 | 56,062,128 | 3,503,883 | 0.97 | 336,732 | 28,061 |
| 1870...... | 37,136,742 | 58,310,464 | 3,644,404 | 0.96 | 367,008 | 30,584 |

Missouri mines; that of the upper mines going mostly to Chicago.

Lead Smelting. The lead mines of the United States being scattered over wide territories, and their products not being generally brought together in large quantities, the process of reducing the ores was, for some years, conducted in small establishments and by the most simple methods. The earlier operations were limited to smelting the ores in log furnaces. Upon a layer of logs placed in an inclosure of logs or stones piled up, split wood was set on end and covered with the ore, and over this small wood again. The pile was fired through an opening in front. The combustion of the small wood removed from the ore a portion of the sulphur, and the reduction was completed by the greater heat arising from the burning of the logs. The lead run down to the bottom and out in front into a basin, whence it was ladled into the moulds. The loss of metal was of course very large; but a portion was recovered by treating the residue in what was called an ash furnace. The process is still resorted to in places where no furnaces are within reach. But of late years extensive smelting works have been erected, both for the smelting of the pure lead and of those ores carrying a greater or less percentage of silver. Those in use are of two sorts: the Scotch hearth and the reverberatory. Besides these, another small furnace is often built for melting over the slags. This is little else than a crucible built in brick-work, and arranged for the blast to enter by an aperture in the back, and for the metal to flow out by another opening in front.

The Scotch hearth is a small blast furnace, but resembles the open forge or bloomary fire for iron ores. It has long been in use in Europe, and is the most common furnace at our own mines. In this country it has been greatly improved by the introduction of hot blast; and in its most perfect form is represented in the accompanying figures; figure *a* being a vertical section from front to back, and figure *b* a horizontal section.




SCOTCH HEARTH FURNACE.

A is the reservoir of lead of the furnace, consisting of a box, open at top, about two feet square and one foot deep, formed of cast iron 2 inches thick. From its upper front edge a sloping hearth, H, is fixed so as to receive the melted lead that overflows, and conduct it by the groove into the basin, B. In this it is kept in a melted state by a little fire beneath, and, as convenient, the lead is ladled out and poured into moulds. D is a hollow shell of cast iron $\frac{3}{4}$ of an inch thick, its inner and outer sides inclosing a space of 4 inches width. Into this space the blast is introduced at E, and becoming heated, passes out at F, and thence through the curved pipe into a tuyere, T, cast in the air-chest 2 inches above the level of the lead reservoir. Before commencing operations this reservoir is to be filled with lead, and is thus kept so long as the furnace is in use; the process being conducted upon the surface of the melted metal. The furnace may be kept in continual operation by adding new charges of galena every ten or fifteen minutes, and working them down after they have become roasted at the surface. The fuel employed is dry pine wood split into small pieces, and billets of these are thrown in against the tuyere just before each new charge of ore, that already in the furnace being raked forward upon the hearth to make room for the fuel, and the blast being temporarily turned off. The old charge is then thrown, together with fresh ore, upon the wood, and the blast is let on, when the heat and flame immediately spread through the materials. The sulphur in the ore serves itself as fuel, accelerating the process by its combustion, and in a few minutes the whole charge is stirred up, spread out on the hearth, and the hard, unreduced fragments are broken in pieces by blows of the shovel. Slaked lime is sometimes added in small quantity when the partially reduced ore becomes too soft and pasty by excess of heat. Its effect is to lessen this tendency rather by mechanical than chemical action. If any flux is used, it is fluor spar, blacksmith's cinders, or bits of iron. The latter hasten the reduction by the affinity of the iron for the sulphur of the ore. The cast iron of the air-chest is protected from the action of the sulphur by the cooling influence of the air blown in; and this is also advantageous by its keeping the furnace from becoming so hot, that the galena would melt before losing its sulphur, and thus form combinations of exceedingly difficult reduction. A fan, run by steam or water power, is commonly employed for raising the blast; but as this gives little pressure, it is replaced to great advantage by blowing cylinders, with an air-receiver for giving regularity to the current of air. With such an apparatus, the smelter can apply the blast with great advantage at times to help loosen up the charge and throw the flame through every part of it. The ores are prepared for smelting by separating from them all the stony and clayey particles, and as much as possible of the blende and other impurities that may accompany them. This may require a succession of mechanical processes, in which the ores are crushed to fine fragments and dressed by jigging and screening under water. Not only is the labor and cost of smelting reduced by the purity of the ore, and especially its freedom from blende and pyrites, but the quality also of the metal is thereby improved. Lead that contains iron is not adapted for the manufacture of white-lead. The American metal being generally free from this brings a higher price than Spanish or English lead. With pure ore a cord of wood may be made to produce four tons of lead ; and each furnace 7,500 lbs. every 24 hours ; a smelter and his assistant managing the operation for 12 hours. At Rossie large quantities of lead have thus been smelted at a daily cost for labor of $5, and for fuel of $1.50, making $1.75 per ton. In Wisconsin, before the use of the hot blast, each furnace-shift was continued from 8 to 10 hours, until 30 pigs of lead were produced of 2,100 lbs. weight, at an expense of about $4 for labor, and $1.50 for fuel.

The other form of furnace—the reverberatory—resembles others of this class employed in smelting copper ores. The sole, or hearth, upon which the ores are spread, is about 8 feet in length by 6 in breadth, and is made to incline rapidly toward an aperture on one side, or at the end under the chimney, and out of which the lead is allowed at the end of each smelting to flow into a receiver outside. The charge is supplied either through a hopper in the arched roof, or through the holes in the sides, which also serve for admitting the pokers used by the workmen to stir up the charge. Unless the galena has been previously calcined or roasted—a process necessary for poor ores only—this is the first thing to be attended to in all the smelting operations. In the large charge of 30 cwt. of ore this usually takes the first two hours of the process, and is effected in great part by the heat remaining in the furnace from the preceding operation, the doors at the sides being kept open at the same time to allow free access of air. The oxidation of the sulphur is expedited by almost constant stirring of the charge, which brings fresh portions to the surface, causing an evolution of white fumes. As these begin to diminish, the fire is started on the grate, and the heat is raised till the charge softens and the pieces of ore adhere to the rake. The doors are then closed, and the fire is urged for a quarter of an hour, when the smelter opens the door to see if the metal separates and flows down the inclined hearth. If the separation does not go on well, it is hastened by opening one of the doors, partially cooling the furnace, and stirring the charge. The fire is then again urged. If the slags which form seem to require it, he treats them with a few shovelfuls of lime and fine coal ; and when, after having flowed down into the lower portion of the hearth, they are brought into a doughy consistency, the smelter pushes the slag to the opposite upper edge of the hearth, from which it is taken out through a door on that side by his assistant, while he lets off the lead into the receiver.

The separation by this method is not so perfect as by the Scotch hearth, and the expense of fuel is greater ; but the reverberatory is worked without the necessity of steam or water power, which is required to raise the blast for the other process. The slags of the reverberatory contain so much lead that they are always remelted in the slag furnace. Those of the Scotch hearth, when pure ores are employed, are sufficiently clear of metal without further reduction. In Europe other sorts of furnaces are in use, which are adapted particularly for ores of poorer quality than are ever smelted in the United States.

In the Hartz mountains, at Clausthal, argentiferous silver ores containing much silica are worked in close cupola furnaces, into which only enough air is admitted to consume the fuel. The object is not to roast out the sulphur, but to cause this to combine with the granulated cast iron or with the quick-lime, either of which is mixed with the ores to flux them and form a fusible compound with the sulphur, through which the metallic lead can easily find its way to the bottom. The production of a silicate of lead is thus avoided, which is a difficult compound to reduce, and is always formed when much silica is present. This process will probably be applied to some of the silicious ores of the United States, and may be particularly suited to the Washoe ores of California.

By all the methods of reducing lead a great loss is incurred by the volatilization of a portion of the lead in white fumes, called lead ashes. These are carried up through the chimney of the furnace and fall upon the ground in the neighborhood, poisoning the vegetation and the water by the carbonate of lead which results from the fumes. Trees even are killed, and the dogs die off, and also the cattle. In Scotland the lead has been detected in chemical examinations of the bodies of animals thus killed, and it was particularly noticeable in the spleen. For the injury thus occasioned at the furnaces of the United States no remedy was applied till recently, but at the great establishments in Europe, where the loss of lead and the damage to the neighborhood is much more serious, attempts have been made to arrest the fumes, by causing them to pass through long flues in the chimney-stacks, in which the particles, on cooling, would settle down; and their cooling has been hastened by showers of water falling among the vapors. Flues have been extended great distances beyond the works, and have been found much more efficient than any form of condensation by sudden cooling. Some of the works constructed for this purpose are very remarkable for their great extent and the saving they have effected, and similar ones have of late been constructed with great advantage at some of the smelting establishments in the United States. At the works of Mr. Beaumont, in Northumberland, England, horizontal or slightly inclined galleries have been completed in stone-work, eight feet high and six feet wide for an extent of 8,789 yards (nearly five miles). This is from one mill alone. The same proprietor has connected with other mills in the same district and in Durham four miles of galleries for the same purpose. The writer who gives the account of these in the recent edition of Ure's Dictionary, by Robert Hunt, remarks: "The value of the lead thus saved from being totally dissipated and dispersed, and obtained from what in common parlance might be called chimney sweepings, considerably exceeds £10,000 sterling annually, and forms a striking illustration of the importance of economizing our waste products." Not only is lead lost in the fumes, but in the working of argentiferous lead ores, a portion of the silver too is carried off and deposited with them. The fumes collected at the works of the Duke of Buccleuch yield one-third their weight of lead, and five ounces of silver to the ton. The loss of silver is of less importance in this country, where this metal is obtained in such quantities in Nevada, Colorado, Idaho, Utah, New Mexico, and Arizona.

In the smelting of argentiferous lead ores, the silver goes with the lead, being completely dissolved and diffused throughout its substance. The usual way of separating it is founded on the principle of the lead being a metal easily oxidized and converted into the substance called litharge, in which condition it lets go the silver, which has no affinity either for the new compound of oxygen and lead, or for the oxygen alone. The change is effected by melting the lead in the shallow basins called cupels, formed of a porous earthy material, as the pulverized ashes of burned bones, kneaded with water, and mixed in a framework of iron. When dried, these are set in a reverberatory furnace, and the pigs of lead are melted upon their surface. After being thoroughly heated, a current of air is made to draw through an opening in the side of the furnace directly upon the face of the melted metal. This oxidizes the lead, and the yellow litharge with more or less red oxide, called minium, collects in a thin film upon its surface, and floats off to the edge, sinking into and incrusting the cupel and falling over its side into a receptacle placed to receive it. This process goes on, the lead gradually disappearing as the oxygen combines with it, till with the removal of the last films of oxide the melted silver suddenly presents its briliant, perfectly unsullied face. The oxide of lead may be collected and sold for the purposes of litharge, as for a pigment, for use in the glass and rubber manufactures; or it may be mixed with fine coal and converted back into lead, the carbon of the coal effecting this change by the greater affinity it has at a high heat for the oxygen, than the lead has to retain it. By this process, known as cupellation, lead is hardly worth treating for silver, unless it contain about ten ounces to the ton of the precious metal ; and it was therefore an important object to devise a method of saving with economy the silver lost in the large quantities of the poorer argentiferous leads. Such a method was accidentally discovered in 1829 by Mr. Pattinson, of Newcastle, and is now extensively in use in Europe for the poorer silver-leads, cupellation being preferred for the richer. He observed that when the lead containing silver forms crystals, as it is stirred while in a melted state, the crystals contain little or none of the silver, and may be removed, thus concentrating the silver in the portions left behind. This crystallizing process is applied in the large way as follows: Cast iron pots are set in brick-work side by side, capable of holding each one 4 or 5 tons of lead. The middle one is first charged, and when the lead is melted and stirred, the fire is removed under the next pot to the right; and into this crystals of lead as they form are ladled by means of a sort of cullender, which lets the fluid lead fall back. This instrument is kept hotter than the lead by frequently dipping it in a pot of lead over a separate fire. When four-fifths of the lead have been transferred to the pot to the right, the remainder, which contains all the silver, is removed to the next pot to the left, and the middle pot is then charged with fresh lead, which is treated in the same manner. The process is repeated with each pot, as it becomes full, four-fifths of its contents going to the next pot to the right, and one-fifth to the next to the left, and thus the lead is finally discharged into moulds at one end, and the argentiferous alloy, concentrated to the richness of 300 ounces of silver to the ton, is run into bars about 2 inches square. From these the silver is obtained by cupellation. At one establishment in England, that of Messrs. Walker, Parker & Co., the weekly product of silver is from 8,000 to 10,000 ounces. The great yield of argentiferous galena of various degrees of richness in silver, in Nevada and the other western states and territories, as well as the moderate percentage of silver in some of the lead mines in Missouri has led to the establishment of smelting works, adopting these and other processes at many prominent points in Nevada, Utah, and Colorado, as well as at Omaha, Chicago, and St. Louis No lead is now sent abroad for smelting.

Useful Applications of Lead.—A considerable part of the lead product of the world is converted into the carbonate, known as white lead, and used as a paint. The principal articles of metallic lead are sheet lead, lead pipe, and shot. Sheet lead is manufactured in two ways. The melted lead is upset from a trough suspended over a perfectly level table, covered with fine sand, and furnished with a raised margin; and when the metal has spread over this, a couple of workmen, one on each side, carry along a bar supported upon the margin, pushing forward the excess of lead above that necessary for the required thickness, till it falls over the end of the table. By the other method, called milling, the lead is cast in a plate, 6 or 7 feet square, and 6 inches thick, and this being taken up by a crane, is placed upon a line of wooden rollers, which form a flooring for the length it may be of 70 or 80 feet and a width of 8 feet. Across the middle of this line are set the two heavy iron rolls by which the lead plate is compressed, as it is passed between them. The top of the lower roll is on a level with the top of the wooden rollers, and the upper roll is so arranged that it can be set nearer to or further from the lower one, as the thickness of the plate requires.

Lead pipe was formerly made by turning up sheet lead and soldering the edges; and is still prepared in this way for the large sizes, as those over six inches diameter. After this a method was contrived of casting the lead in a hollow cylindrical plug, its inner diameter of the bore required, and then drawing this down through slightly conical dies of decreasing diameter, a mandril or steel rod being inserted to retain the uniform diameter of the bore. Pipes made in this way were limited to 15 to 18 feet in length, and the metal was full of flaws. Many attempts have been made to cast long lengths of lead pipe, all of which have proved unsuccessful. In 1820 Thomas Burr, of England, first applied the hydraulic press to forcing lead, when beginning to solidify in cooling, through an annular space between a hollow ring and a solid core secured in its centre. He thus produced pipes of considerable length. The method of forcing the liquid metal through dies to form pipes was, however, first patented in 1797 by Bramah, who used a pump for this purpose. The process was introduced into this country in 1840–41 by Messrs. Tatham & Brothers, now of New York, who invented and patented an important improvement in the method of securing the die and core. In this operation the melted lead is made to flow from the furnace into a cylindrical cavity in a block of cast iron, which may be of 1800 lbs. weight, and from this, when cooled to the proper temperature, it is forced out through the die by a closely-fitting piston. By one process the piston, starting from the bottom of the cylindrical cavity, moves upward, carrying with it the slender core or rod which determines the diameter of the bore of the pipe, and pushes the melted lead before it through the die fixed in the top of the cast iron block. The pipe as it is formed passes out from the top of the machine, and is coiled around a receiving drum. By the machine contrived by Mr. Cornell of New York, the great iron block containing the lead rises by the pressure of the hydraulic machine, and the piston which is fixed above it enters the cavity. The piston in this case is hollow and the die is set in its lower end. The core is secured in the bottom of the block, and is carried upward as this rises. The pressure applied in this operation amounts to 200 to 300 tons. Dies are used of a great variety of sizes, according to the kind of pipe required. Lead wire is made in this way with a die of very small size without a core. It is used for securing vines and attaching tags to fruit trees and shrubs. The principal works in the United States engaged in the manufacture of sheet lead and lead pipe are in New York, Boston, Providence, Philadelphia, Chicago, Cincinnati, St. Louis, and Omaha.

Lead pipe is in general use as the most convenient conduit for water for domestic purposes. It is readily bent to any angle, and is made to adapt itself to any position. When water freezes within and bursts it, the damage is easily repaired; joints are also made with little trouble. The lead is not liable to become rusty like iron, and is cheaper than tin or copper. These qualities give to it a preference over other kinds of pipe, notwithstanding the very serious objection that the lead is often acted upon by the water, and produces poisonous salts of a very dangerous character. Some waters more than others have a tendency to promote the oxidation of the lead. This is particularly likely to occur with nearly all waters in pipes which are alternately exposed to the action of air and water, as when the water being drawn out, the air enters and takes its place. The oxide of lead is converted by carbonic acid gas, which is present in almost all water, into a carbonate of lead which is soluble to some extent in an excess of the gas, and is carried along, bearing no indication of its presence, while the lead pipe continues to be corroded until it may be in places eaten nearly through. The water used for drinking and for culinary purposes is thus continually introducing an insidious poison into the system, the effect of which is at last experienced in the disease known as the painters' colic, often followed by paralysis. As this occurs without a suspicion being awakened of the real source of the disease, and is produced by quantities so small as from $\frac{1}{10}$ to $\frac{1}{20}$ of a grain in the gallon, the use of lead pipe is properly regarded by scientific men as always unsafe; and some substitute for this metal in pipes and in sheets used for lining water cisterns, is highly desirable. It has been proposed to coat the pipe with some insoluble lining; but such an application necessarily increases its cost, it may perhaps be removed by hot water flowing through the pipe, and the purchaser may have no confidence in the coating being faithfully applied, or as certain to be efficient during long-continued use. Block tin is perfectly safe, but it is expensive, and is moreover likely to be alloyed with the cheaper metal lead, which in this condition is thought to be equally dangerous as when used alone. As no popular substitute for lead is provided, it is a reasonable precaution for those employing it to be always watchful and on their guard against its evil effects—using as little of it as necessary, causing the water to be occasionally tested, and, whenever opportunity offers, cutting open and examining pieces of the pipe to see whether its internal surface is corroded, and every morning before using the water that has stood in the pipes, to cause this to flow away together with enough more to thoroughly wash out the pipes and remove any salts of lead that may have formed in them during the night.

Large quantities of lead are consumed in the United States in the manufacture of shot and bullets; and one ingenious method of producing shot is an American invention.

The quality of the lead employed for this purpose is of little importance. The harder and inferior sorts, which would not answer for the white lead manufacture, are economically diverted to this object. If too brittle, from the iron and antimony combined with the lead, the metal is made to assume the right quality by mixing with it a small proportion of arsenic, which, for most kinds of lead, may amount to one per cent. To introduce this into the lead a large pot of the metal is melted, and powdered charcoal or ashes is laid around its edge. The arsenical compound, either of white arsenic or of orpiment (the sulphuret of arsenic), is then stirred into the centre of the mass, and a cover is tightly luted over the pot. In the course of a few hours, the mixture being kept hot, the combination of the lead with the arsenic is completed, and a portion of litharge floats upon the surface. This is formed from the oxygen of the white arsenic uniting with some of the lead, and it retains a portion of the arsenic. The alloy is now tried by letting a small quantity of it fall from a moderate height through a strainer into water. From the appearance of the globules the quality of the mixture is judged of. If they are lens-shaped, too much arsenic has been used; but if they are flattened on the side, or hollowed in the middle, or drag with a tail behind them, the proportion of arsenic is too small. When a proper mixture is obtained it is run into bars, and these are taken to the top of a tower, from 100 to 200 feet high, where the lead is melted and poured through cullenders, which are kept hot by being placed in a sort of chafing-dish containing burning charcoal. The lead is thus divided into drops that fall to the bottom, and are received in a vessel of water. Each cullender has holes all of the same size, which is considerably less than that of the shot produced by them. This is owing to the drop of melted lead first assuming an elongated form, which is concentrated into the globular by the air impinging equally upon all sides in the course of its descent. When it reaches the water, it is important that it should have cooled throughout, so that no solid crust be suddenly formed over a fluid interior; and hence, for large shot it is evident the height of the fall must be greater than is required for small shot. The temperature of the lead also, when it is dropped, must vary according to the size of the shot; for the largest size being so low that a straw is hardly browned when thrust into it. A portion of the lead becomes oxidized and is caught in the cullender, the bottom of which it coats, and serves a useful purpose by checking the too rapid flow of the melted lead through the holes. The holes vary in size, from $\frac{1}{50}$ of an inch for shot larger than No. 1, to $\frac{1}{360}$ of an inch for No. 9. The shot being taken out of the water and dried upon the surface of a long steam chest, are transferred to an iron cask suspended upon an axis passing through its ends, and a little plumbago being introduced with them, the cask is made to revolve until the shot are thoroughly cleaned and polished. The next operation is to separate the imperfect ones from the good. This is done by rolling them all together down a succession of inclined platforms, separated by a narrow space between each. The good shot clear these spaces and are caught below, while the bad ones fall through upon the floor. The good are then introduced into the sifters for assorting them according to their sizes. Several sieves are arranged like drawers in a case; the coarsest above, and finer ones succeeding below. The upper tier of sieves being charged, the case is set rocking, and the shot are soon assorted, and are then ready for packing in bags. Bullets and buck-shot are moulded by hand from a large pot of the metal into moulds with many receptacles.

The American process of shot-making was invented in 1848 by David Smith, of the firm of T. O. Leroy & Co., of New York, by whom it is exclusively used. Its object is to dispense with the use of the costly high towers, by substituting for them a lower fall against an ascending current of air. This current is produced by a fan-blower operating at the base of an upright hollow shaft into which the shot are dropped from a moderate height. The power required to run the fan is not much more than that ordinarily expended in raising the lead to the top of the high towers; and it is found that the lead, in consequence of its being more rapidly and equally cooled in the short descent against the current of air, may be used at a higher temperature than is practicable with that dropped from high towers; and thus it may not only be poured more rapidly, but it has not the tendency to burst in falling and form imperfect shot, as is the case with that dropped from high towers, to guard against which the lead is kept at a low temperature.

There are in New York city, besides this operation, which is carried on by Messrs. Leroy, in Water street, three shot towers, and a fourth is nearly completed on Staten Island. The ordinary capacity of these is from 3000 to 4000 tons of shot per annum. The annual shot production of St. Louis is about the same as that of New York, though there is now only one shot tower in use. There were formerly seven more on the river bluffs below the city, but these have hardly been used since 1847. In Baltimore is a tower the height of which, including ten feet constructed below the surface of the ground, is 256 feet, which exceeds by one foot the height of the famous tower in Vienna, described by Dr. Ure as the highest structure of the kind in the world, being 249 feet above the surface of the ground. Its production is stated to be about 400 tons per annum. In Philadelphia there is one tower which makes about 300 tons annually; in Wythe county, Virginia, is one formed in one of the shafts of the mine, making about 200 tons; and on the Wisconsin river, at Helena, is a small tower probably making about as much more. The actual production of the country in shot and bullets is supposed to be about 7000 tons, and to have made but little advance for many years past.

White Lead.—Before the introduction of the oxide of zinc as a paint, one of the most important uses of lead was its conversion into the carbonate or white lead. The manufacture was originally carried on almost exclusively in Holland; and it was not until near the close of the last century that it was introduced into England. In the United States it was unknown until after the war of 1812, and being first undertaken in Philadelphia, it was afterward extended to New York and Brooklyn, and in the latter city has prospered more than in any other part of the country. Various attempts have been made to introduce new methods of manufacture, but the old Dutch process has continued in general use; the modifications of it which have raised the manufacture in this country to a higher state of perfection than in any other part of the world being merely improvements in the details, by which ingenious machinery has been made to diminish the labor expended in the process.

White lead is a combination of oxide of lead with carbonic acid, and is obtained in the form of a soft, very white, and heavy powder. It mixes readily with oil, giving to it a drying property, spreads well under the brush, and perfectly covers the surfaces to which it is applied. It is not only employed alone as the best sort of white paint, but is the general material or body of a great number of paints, the colors of which are produced by mixing suitable coloring matters with the white lead. Besides its use as a paint it is also in demand to a considerable extent as an ingredient in the so-called vulcanized india-rubber. To prepare it, the purest pig lead, such as the refined foreign lead and the metal from the mines of the western states, is almost exclusively used. This was by the old methods made in thin sheets, and these into small rolls, to be subjected to the chemical treatment. But according to the American method devised by Mr. Augustus Graham of Brooklyn, and now generally adopted, the lead is cast into circular gratings or "buckles," which closely resemble in form the large old-fashioned shoe-buckles, from which they receive their name. They are six or eight inches in diameter, and the lead hardly exceeds one sixth of an inch in thickness. Ingenious methods of casting them are in use in the American factories, by which the lead is run upon moulds directly from the furnace, and the buckles are separated from each other and delivered without handling into the vessels for receiving them. They are then packed in earthen pots shaped like flower-pots, each of which is provided with a ledge or three projecting points in the inside, intended to keep the pieces above the bottom, in which is placed some strong vinegar or acetic acid. It is recommended that on one side the pot should be partially open above the ledge, and if made full all round, it is well to knock out a piece in order to admit a freer circulation of vapors through the lead. In large establishments an immense supply of these pots is kept on hand, the number at the single manufactory of Messrs. Battelle & Renwick, on the Hudson, being not less than 200,000. They continue constantly in use till accidentally broken below the ledge. These are packed close together in rows upon a bed of spent tan, a foot to two feet thick, and thin sheets of lead are laid among and over the pots in several thicknesses, but always so as to leave open spaces among them. An area is thus covered, it may be twenty feet square or of less dimensions, and is enclosed by board partitions, which, upon suitable framework, can be carried up twenty-five feet high if required. When the pots and the interstices among them are well packed with lead, a flooring of boards is laid over them, and upon this is spread another layer of tan; and in the same manner eight or ten courses are built up, containing in all, it may be, 12,000 pots and 50 or 60 tons of lead, all of which are buried beneath an upper layer of tan. As the process of conversion requires from eight to twelve weeks, the large factories have a succession of these stacks which are charged one after another, so that when the process is completed in one, and the pots and lead have been removed and the chamber is recharged, another is ready for the same operation.

The conversion of metallic lead into carbonate is induced by the fermenting action, which commences in the tan soon after the pile is completed. The heat thus generated evaporates the vinegar, and the vapors of water and acetic acid rising among the lead oxidize its surface and convert it externally into a subacetate of lead; at the same time carbonic acid evolved from the tan circulates among the lead and transforms the acetate into carbonate of the oxide, setting the acetic acid free to renew its office upon fresh surfaces of lead. When the tan ceases to ferment the process is at an end, and the stack may then be taken to pieces. The lead is found in its original forms, but of increased bulk and weight, and more or less completely converted into the white carbonate. The thoroughness of the operation depends upon a variety of circumstances; even the weather and season of the year having an influence upon it. The pieces not entirely converted have a core of metallic or "blue" lead beneath the white carbonate crust. The separation is made by beating off the white portion, and this being done upon perforated copper shelves set in large wooden tanks and covered with water, the escape of the fine metallic dust is entirely prevented and its noxious effect upon the health of the workmen is avoided. In Europe, rolling machines closely covered are applied to the same purpose, but less effectually. The white lead thus collected is next ground with water between millstones to a thin paste, and by repeated grindings and washings this is reduced to an impalpable consistency. The water is next to be removed, and, according to the European plan, the creamy mixture is next turned into earthen pots, and these are exposed upon shelves to a temperature not exceeding 300° until perfectly dry. Instead of this laborious method, the plan is adopted in the American works of employing shallow pans of sheet copper, provided with a false bottom, beneath which steam from the exhaust-pipe of the engine is admitted to promote evaporation. These pans or "drying kilns" are sometimes 100 feet long and 6 feet broad, and several are set in the building one above another. The liquid lead paste is pumped up into large tanks, and the heavier portion settling down, is drawn off into the pans, while the thinner liquid from the surface is returned to be mixed with fresh portions of white lead. Beside pans, tile tables heated by flues in the masonry of which they are built, are also employed. From four to six days are required for thoroughly drying the white lead. This is the finishing process, after which the lead is ready for packing in small casks for the market.

The manufacture of white lead, which was formerly an unhealthy and even dangerous occupation, has been so much improved by the expedients for keeping the material wet and thus preventing the rising of the fine dust, that the peculiar lead disease now rarely attacks the workmen. The business is conducted altogether upon a large scale, and gives employment to numerous extensive factories in different parts of the country. Some of these have arrangements for converting-stacks that extend under cover 200 feet in length, and their facilities for grinding and drying are proportionally extensive. These, and the time required for fully completing the process and getting the white lead ready for market—which is from three to four months—involve the use of large capital and tend to keep the business in few hands.

There is a vastly increasing demand for pure white lead, and the competition and watchfulness of the trade insure the genuineness of the article thus warranted by the manufacturers. A large class of customers are the grinders, who form a distinct trade, and use and mix the pure article with other substances and with coloring matters to suit their purposes. The mineral, sulphate of barytes or heavy spar, is the chief article used to adulterate white lead, and for this purpose it is obtained from mines in

Connecticut and other places, and is extensively ground in mills for this use alone. When perfectly pure, the powder is absolutely white; it has about the same weight as white lead, and is quite as indestructible; it is, indeed, less acted upon or discolored by noxious vapors. It lacks, however, the body of white lead, and is not so brilliant; and whenever used in any proportion materially injures the paint in those good qualities. Oxide of zinc is also largely mixed with white lead, as will be noticed more particularly in the succeeding chapter.

The principal white lead works, together with the probable amount of their annual production in the United States in 1870 were as follows:—

| Location. | No. of Works. | Amount of Production. |
|---|---|---|
| Brooklyn, N. Y., | 5 | $882,000 |
| New York City, | 4 | 685,000 |
| Staten Island, N. Y., | 1 | 360,000 |
| Saugerties, N. Y., | 1 | 220,000 |
| Buffalo, N. Y., | 1 | 165,000 |
| Philadelphia, Pa., | 16 | 2,479,408 |
| Pittsburgh, Pa., | 5 | 1,281,320 |
| Baltimore, Md., | 3 | 640,000 |
| Boston, Mass., | 5 | 1,147,500 |
| Salem, Mass., | 2 | 490,000 |
| Jersey City, N. J., | 2 | 248,000 |
| Trenton N. J., | 1 | 105,800 |
| Cincinnati, Ohio, | 4 | 506,880 |
| Cleveland, Ohio, | 4 | 244,400 |
| Springfield, Ohio, | 2 | 100,000 |
| Canton, Ohio, | 1 | 150,000 |
| Indianapolis, Ind., | 1 | 145,600 |
| Louisville, Ky., | 2 | 265,500 |
| Chicago, Ill., | 4 | 544,400 |
| St. Louis, Mo., | 8 | 2,083,000 |
| All others, | 3 | 120,000 |
| Total, | 75 | $13,163,808 |

In the last decade, this business has increased immensely. Brooklyn, the first place on the list, reports in the census of 1880, 28 establishments, producing white lead to the amount of $8,442,938, almost two-thirds of the entire production of 1870. There has been a great increase, also, in New York City, Philadelphia, Pittsburgh, Cincinnati, Chicago, and St. Louis.

## CHAPTER V.

### ZINC.

The production of the zinc mines has been steadily increasing since they were first worked about forty years since; and the metal is applied to some purposes for which lead has heretofore been almost exclusively used. The growing importance of this product in the United States will justify a reference to the zinc manufacture of Europe.

The metal, as mentioned in the chapter on Copper, very curiously escaped the notice of the ancients, though they obtained it from its ores in preparing brass, an alloy of copper and zinc. In the metallurgical processes it is readily sublimed by heat, and when its fumes come in contact with the air they are immediately oxidized, burning with a greenish-white flame, and are then converted into the white oxide of zinc, a compound of one equivalent of the metal = 34, and one of oxygen = 8; which correspond respectively to 81 and 9 per cent. These fumes when collected are found to be a white flocculent powder, now known as the white oxide of zinc, or zinc paint. If the vapor of zinc be protected from contact of air and passed through pipes into water, it is condensed into metallic drops, and these may be melted in close vessels and poured into moulds. Cast zinc is a brittle metal of bluish white color and greater luster than that of lead. By heating it to the temperature of 212° to 300° F. it entirely loses its brittleness, and is made malleable and ductile, so that it can be rolled out into sheets. Its melting point is 680°, while that of lead is 608.°

A variety of ores are worked for this metal; as the sulphide, called blende; the carbonate, called smithsonite; and the silicate of zinc, or calamine. The last two usually occur associated together. The red oxide is an important ore, but found only in New Jersey. Blende almost universally accompanies galena, and in some lead mines is the prevailing ore. The miners call it black jack. When pure, it consists of zinc 67, sulphur 33. Being more difficult to reduce than the other ores, it has been comparatively little used, though the Chinese are known to have been successful in their management of it. In the United States it lies valueless in immense quantities about many of the lead mines; but it is not improbable the old refuse heaps will yet be turned to profit. At the zinc works near Swansea, in Wales, it has been worked for many years; and in England it has for a few years past come into use. In 1855, it is reported that 9,620 tons of this ore from various mines were sold; while of the calamine ores, the produce of the Alston Moor mines, sales of only 182 tons were reported. More ores of each sort were no doubt smelted, but the proportion of each was probably not very different from that stated. Dr. Ure, in his dictionary, speaks of this ore selling at Holywell for £3 per ton. In France there are now five establishments working blende; while in 1840, all the zinc consumed in the country was imported. Smithsonite resembles some yellowish or whitish limestones, and usually accompanies these rocks, being irregularly bedded among their strata. In its best condition it is obtained in large blocks of botryoidal and reniform shapes, sometimes crystallized. But usually it is in porous crumbly masses, much mixed and stained with reddish oxide of iron. The pure ore contains 65 per cent. of oxide of zinc (which is equivalent to 52 of the metal) and 35 of carbonic acid. The silicate of zinc is found intermixed with the carbonate, which it resembles in appearance. It contains, when pure, silica 25.1, water 7.5, and oxide of zinc 67.4, corresponding to 54 per cent. of the metal. The red oxide is found only at Mine Hill and Stirling Hill, near Franklin, in the extreme northern county of New Jersey. The pure oxide, of which it is almost exclusively composed, contains 80.26 per cent. of zinc, and 19.74 of oxygen. The bright red color is probably derived from the small quantity of oxide of manganese present. The ore is mixed with franklinite iron ore, each being in distinct grains. one red and the other black; and with these is associated a white crystalline limestone, either in disseminated grains with the ores, or forming the ground through which they are dispersed. Two beds, consisting of the zinc and iron ores, lie in contact with each other along the southeastern slope of the Stirling Hill, between the limestone of the valley and the gneiss of the ridge, dipping with the slope of these rocks about 40° toward the valley, and ranging northeast and southwest. The upper bed, varying from three to eight feet in thickness, consists of more than 50 per cent. red oxide of zinc; and the lower bed, which is twelve feet thick, and in some places more than this, is chiefly franklinite, changing to limestone below, interspersed with imperfect crystals of franklinite. At Mine Hill, one and a half miles northeast from Stirling Hill, two distinct beds are again found together, that containing the most zinc in this case being the under one of the two, lying next the gneiss. These localities have been well explored; the beds have been traced considerable distances along their line of outcrop; and at Stirling Hill the red oxide of zinc has been mined for more than ten years by the New Jersey Zinc Company. Their workings have reached to a depth of about 250 feet, and have afforded the finest specimens of zinc ore ever seen. A single mass of the red oxide was sent, in 1851, to the Great Exhibition, in London, which weighed 16,400 lbs., and attracted no little attention, from the purity, rarity, and extraordinary size of the specimen. The Passaic Mining and Manufacturing Company also have opened two beds of the same ore on their property at Stirling Hill, adjoining that of the New Jersey Zinc Company, and between 1854 and 1860 took out about 30,000 tons of rich and lean ores. At the depth of 178 feet, the principal bed is twenty-one feet wide, of which about two and a half feet is rich ore, and the rest limestone sufficiently interspersed with oxide of zinc to render it worth dressing. This company completed, in the year 1859, at the mines, very extensive works for dressing the lean ores before they were shipped to their furnaces at Jersey City. The principal supplies of their ores hitherto have been of the smithsonite and calamine from the mines in the Saucon valley, Lehigh county, Pennsylvania, of which they mined about 5,000 tons in the first year. These ores are extensively worked to the north of Friedensville, both by this company and the Pennsylvania and Lehigh Zinc Company, whose furnaces are at Bethlehem, in Lehigh county. The mines of the two companies, which are near together, are known as the Saucon mine and the Lehigh Zinc Company's mine. They were first opened in 1853. The two kinds of ore are found together, as is common in the European mines, and more or less blende is interspersed among them. They form very large irregular beds in limestone of the lower Silurian period, and are penetrated by veins of quartz which traverse both the ore and limestone. The deepest workings at the Saucon mine are about 700 feet below the surface; and from this depth galleries have been run in every direction, exposing to view many thousand tons of ore. The ores of best quality are found in the lower workings. Since 1876 work on this mine has been stopped by water, the cost of removing which exceeded the value of the ore.

About the same time that these mines were opened in Lehigh county, another, producing similar kinds of zinc ore, was discovered near Lancaster, in Pennsylvania; but after being explored it was found to contain so much blende and galena, that it was abandoned as useless. Subsequently it was worked with moderate success. Large deposits of the same varieties of zinc ore are known to exist in Tennessee; one locality at Mossy Creek, a few miles northeast of Knoxville, and another at Powell's river, a branch of the Clinch river, in Campbell county, about forty miles north of Knoxville. These beds contained very large quantities of excellent ore. The former, being close to the East Tennessee and Virginia railroad, was very conveniently situated; and the other was within half a mile of a river navigable at certain seasons by flat-boats. Below its junction with the Clinch river were beds of bituminous coal, and the river was thence navigable by steamboats. At Kingston it was crossed by a railroad.

Zinc, either in the form of blende, carbonate, or calamine, is found in all the states west of the Mississippi river, oftenest in combination with lead, but sometimes by itself, and more rarely with silver, gold, tellurium, arsenic, or antimony. In Arkansas, Missouri, Iowa, Wisconsin, Kansas, Colorado, New Mexico, and perhaps in Utah and Texas, it is reduced (the much-despised blende or sulphide being under later processes utilized) either by itself or in the process of separation from silver and lead, as the white oxide of zinc. It is now produced so abundantly that the price is but little higher than that of lead; zinc being quoted at $120 per ton, and lead at $100. The imports of zinc, which in 1869 and 1870 were from $1,000,000 to $1,500,000, are now only nominal, and are balanced by the exports. It is impossible to determine how far "zinc-white" — the white oxide of zinc—is taking the place of the white lead as a paint, because the manufacturers of the one are also manufacturers, or at least sellers, of the other, and report them together. Zinc-white is more easily produced than white lead, is said to give a more brilliant and equally durable color, and to be free from the tendency to poison the painters. Its cost is slightly greater, though there seems to be no good reason why it should be.

### METALLURGIC TREATMENT AND USES.

Zinc ores are applied to practical purposes, not only to produce the metal, but also the white oxide of zinc, which is considerably used as a paint. The ancients used an ore they called *lapis calaminaris*, to make brass, by melting it with copper in crucibles, not knowing that another metal was thus formed which produced an alloy with the copper. Although the metal was discovered in the 16th century, the nature of its ores was little known before the middle of the last century. It is now prepared upon a large scale in Belgium and Silesia, and small quantities are produced in England, France, and different parts of Germany. The simple method of obtaining zinc from its ores, called distillation *per descensum*, was introduced into England about the year 1740, and was derived from the Chinese, who appear to have been acquainted with the metal long before it was known to the Europeans. As now practiced in Great Britain, the ores are first calcined, the effect of which is to expel a portion of the water, carbonic acid, and sulphur they contain. They are then ground to powder, and mixed with fine charcoal, or mineral coal, and introduced into stationary earthern pots or crucibles. When set in the furnace, an iron pipe, passing up through the bottom of the hearth, enters the crucible, and connects with an open vessel directly beneath. About six pots are set together under a low dome of brick-work, through which apertures are left for filling them. Each one has a cover, which is luted down with fire clay; and the iron tube in each is stopped with a wooden plug, which, as the operation goes on, becomes charred and porous, so as to admit through it the passage of the zinc vapors. The tubes are prevented from being clogged with depositions of the condensed zinc, by occasionally running a rod through them from the lower end. The zinc collects in the dishes under the tubes, in the form of drops and powder, a portion of which is oxidized. The whole is transferred to melting-pots, and the oxide which swims upon the surface of the melted metal is skimmed off and returned to the reducing crucibles, while the metal is run into molds. The ingots are known in commerce as spelter.

In the United States zinc was first made by Mr. John Hitz, under the direction of Mr. Hassler, who, by order of Congress, was engaged about the year 1838 to manufacture standard weights and measures for the custom-houses. The work was done at the U. S. arsenal at Washington, the ores used being the red oxide of New Jersey. The expense exceeded the value of the metal obtained, and it was generally supposed that we could not produce spelter so cheaply as it could be imported from Europe. The next experiments were made at the works of the New Jersey Zinc Company, 1850, on the Belgian plan. In these great difficulties were experienced for want of retorts of sufficiently refractory character to withstand the high temperature and the chemical action of the constitutents of the ore. The franklinite, which always accompanies the red oxide ores, was particularly injurious, by reason of the oxide of iron forming a fusible silicate with the substance of the retorts. These trials consequently failed after the expenditure of large sums of money. The next important trial was made in 1856, by a Mr. Hoofstetter, who built a Silesian furnace of twenty muffles for the Pennsylvania and Lehigh Zinc Company at their mine near Friedensville. This proved a total failure, and seemed almost to establish the impracticability of producing spelter with the American ores, clays, and anthracite. About this time, Mr. Joseph Wharton, the general manager of the Pennsylvania and Lehigh Zinc Company, and Mr. Samuel Wetherill, of Bethlehem, both hit upon the same plan of treating zinc ores in an open furnace, and leading the volatile products through incandescent coal, in order to reduce the zinc oxide so formed, and draw only metallic and carbonaceous vapors into the condensing apparatus. Mr. Wharton constructed his furnace in Philadelphia, and Mr. Wetherill his in Bethlehem. The former having completed his trials, filed a caveat for the process, but soon after abandoned it as economically impracticable. The latter continued his operations, patented the method, and produced some zinc, eight or ten tons of which were sold to the U. S. Assay Office in New York. The manufacture was not, however, long continued. In 1858, Mr. Wetherill recommended the production of zinc, adopting a plan of upright retorts, somewhat like that in use in Carinthia, in Austria, and that of the English patent of James Graham. Mr. Wetherill had succeeded in procuring good mixtures of fire clays, and his retorts made of these and holding each a charge of 400 pounds of ore, proved sufficiently refractory for the operation. The works under his charge at Bethlehem, erected in 1858–59, and belonging to the owners of the Saucon mine, had a capacity of about two tons of metal daily.

Mr. Wharton, after abandoning the method of reduction by incandescent coals, continued his experiments on different plans, and finally decided on the Belgian furnace as the best, after having actually made spelter from silicate of zinc, with anthracite, in muffles of American clays, at a cost below its market value. These trials were made in the zinc oxide works of the Pennsylvania and Lehigh Zinc Company. Their success encouraged the company to construct a factory at Bethlehem for reducing zinc ores, and this was done under the direction of Mr. Wharton in 1860. The capacity of the works was about 2,000 tons per annum, and their actual daily product in the first year was over three tons. Four stacks or blocks were constructed, each containing four furnaces. To each furnace there were 56 retorts, making in all 896, working two charges in twenty-four hours. Their total capacity was about five tons of metal. Besides the ordinary spelter of this manufacture, which, as will be seen by the remarks that follow, was remarkable for its freedom from injurious mixtures, and was the best commercial zinc in the world, Mr. Wharton also prepared from selected ores a pure zinc for the use of chemists, and for purposes in which a high degree of purity was essential. This was cast in ingots of about nine pounds each, and was sold at the price of ten cents per pound. For the supply of chemists, and for the batteries employed by the telegraph companies, the American zinc of this manufacture was preferred to all others. The total annual consumption of crude spelter in the United states amounts to about $1,500,000; and the value of sheet zinc, nails, etc., is about as much more.

The commercial zincs, it has long been known, are contaminated by various foreign substances, the existence of some of which is indicated in the finely divided black substance which remains floating or sinking in the liquid, when the metal is dissolved in dilute acids. The impurities have been stated by different chemists to consist of a great variety of substances, such as lead, cadmium, arsenic, tin, iron, manganese, carbon, etc. They injuriously affect the quality of the metal for many of its uses; and the presence of one of them, arsenic, is fatal to the highly important use of zinc by chemists, as a reagent in the detection of arsenic in other substances. Arsenic in the form of a sulphuret often accompanies the native sulphurets of zinc, and its oxide, being volatile, is readily carried over with the zinc fumes in the metallurgic treatment of blende, and may thus be introduced into the spelter. It is evidently, therefore, a matter of consequence to know the qualities of the different zincs of commerce, and the exact nature of the impurities they contain. Very thorough investigations having these objects in view were made in 1860 in Cambridge, Mass., by Messrs. Charles W. Eliot and Frank H. Storer, of Boston, and the results of these, with a full description of their methods of examination, were communicated to the American Academy of Arts and Sciences, and published in the eighth volume of the new series of their Memoirs. Eleven varieties of zinc from different parts of Europe, and made from the ores of New Jersey, and of the Saucon valley, Pennsylvania, were experimented upon, of all of which large samples were at hand. These varieties were the following: 1, Silesian zinc; 2, Vieille Montagne zinc; 3, New Jersey zinc; 4, Pennsylvania zinc, Bethlehem, Pennsylvania; 5, Vieille Montagne zinc, employed at the United States mint, Philadelphia; 6, zinc of MM. Rousseau-Frères, Paris, labelled and sold as *zinc pur;* 7, sheet zinc obtained in Berlin, Prussia; 8, zinc made near Wrexham, North Wales; 9, zinc from the Mines Royal, Neath, South Wales: 10, zinc from the works of Dillwyn & Co., Swansea, South Wales; 11, zinc from the works of Messrs. Vivian, Swansea. All of these, except the Pennsylvania zinc, furnished an insoluble residue, which was found to consist chiefly of metallic lead, and this proved to be the principal impurity of all the samples examined; "the carbon, tin, copper, iron, arsenic, and other impurities found in the metal by previous observers, occur either in very minute quantities, or rarely, and doubtless accidentally." The proportions of lead present in 100 parts of each of the varieties examined were respectively as follows: in No. 1, 1.46; 2, 0.292; 3, 0.079; 4, 0.000; 5, 0.494; 6, 0.106; 7, 1,297; 8, 1.192; 9, 0.823; 10, 1.661; 11, 1,516. The New Jersey zinc was found to contain a sensible quantity of tin, copper amounting to 0.1298 per cent., iron 0.2088 per cent., and an unusually large amount of arsenic. Traces of this were also detected in the white oxide prepared from the ores of the New Jersey mines, and in the red oxide ore itself; but the same ore afforded no clue as to the source whence the copper was derived, a metal of which not the slightest traces were discoverable in the other zincs. None of the samples contained sufficient arsenic to admit of its proportion being determined, and some were entirely free from it, as some of the Belgian and Pennsylvania spelter, but traces of it were met with in other samples from the same regions, indicating that the occasional use of inferior ores, such as blende, intermixed with the carbonates and silicates, might introduce this substance, or possibly it might come over only in the first part of the distillation, and the zinc collected in the latter part might be quite free from it. The Silesian zinc contained minute quantities of sulphur, and arsenic; and the English zinc more arsenic than any other, except, perhaps, the New Jersey. The purest of all the samples was that from Bethlehem, Pennsylvania, some of it yielding no impurity, except a trace of cadmium. As the authors of the paper remarked, there seemed to be no reason why zinc of uniform purity should not be obtained from the excellent ores of the Saucon valley mines, and they are now obtained of equal excellence from the western mines.

#### EUROPEAN MANUFACTURE.

A large portion of the zinc and zinc paints used in the United States was furnished for many years by the works of the Vieille Montagne Company, established near the frontier of Belgium and Prussia, chiefly in the province of Liege, of the former country. Though we are now nearly independent of this source of supply, yet the processes adopted there for mining and reducing zinc ores may be of interest and importance to those who are engaged in its production here. A large number of mines are worked in this region, the most important of which is that of the Vieille Montagne or Altenberg, situated in the village of Moresnet, between Aix-la-Chapelle and the town of Liege. It is said that the great body of carbonate of zinc found here was worked as long ago as the year 1435, and that for four centuries it was not known that the ore was of metallic character, but it was used as a peculiar earth adapted for converting copper into brass. The ore lies in a basin-like depression in strata of magnesian limestone, and is much mixed with beds of clay intercalated among its layers. The ore is chiefly carbonate mixed with the silicate and oxide of zinc. Some of it is red, from the oxide of iron intermixed, and this produces only about 33 per cent. of metal. The purer white ore yields about 46 per cent., and is moreover much preferred on account of its working better in the retorts. The furnaces employed in the distillation of these ores are constructed upon a very large scale, and on a different plan from those in use in Great Britain. The general character of the operations, however, is the same. The ores are first calcined, losing about one fifth of their weight. They are then ground in mills, and charges are made up of 1100 lbs. of the powdered ore mixed with 550 lbs. of fine coal. The mixture being well moistened with water, is introduced into cylindrical retorts, which are three feet 8 inches long and 6 inches diameter inside, set inclining outward, to the number of 42 in a single furnace, and 4 such furnaces are constructed in one stack. The open end of each retort connects, by means of an iron adapter 16 inches long, with a wrought-iron cone, the little end of which, projecting out from the furnace, is only an inch in diameter. After the charges have been sufficiently heated, the sublimed zinc condenses in the neck of the retort and in the adapter and cone. The last two are then removed, and the zinc and oxide are collected from them, and the liquid metal in the neck of the retorts is drawn out and caught in a large ladle, from which it is poured into moulds. The zinc thus obtained is remelted before it is rolled. Two charges are run through in twenty-four hours, each furnace producing from 2200 lbs. of ore about 620 lbs. of metal, which is about 30 per cent. From a late report of these operations it appears that there are seven large smelting establishments belonging to the Vieille Montagne Zinc Mining Company, on the borders of Belgium and Prussia, comprising 230 furnaces. The annual product of these is 29,000 tons of spelter, of which 23,000 tons are converted into sheet zinc, and about 7000 tons are rolled at mills not the property of the company. They also manufacture oxide of zinc in three establishments devoted to this operation, to the amount of about 6000 tons annually. The company also purchases spelter very largely.

The metallurgy of zinc has, within a few years past, become an important branch of industry in Upper Silesia on the borders of Poland, and not far from Cracow. In 1857 there were no less than 47 zinc works in this part of Prussia, one of which, named Lydogniahütte, at Königshütte, belonged to the government, and the remainder were owned by private companies and individuals. In that year their total production was 31,480 tons of spelter, valued at about 17,660,000 francs. Many of the establishments belong to the Silesian Company, which also owns several coal mines near their works, and a number of zinc mines. The government works are supplied with ores from their own mines, and also from all the others, being entitled to one twentieth of their product. From a description of the operations published in the sixteenth volume of the *Annales des Mines*, fifth series, 1859, it appears that the processes are the same which had been employed for full twenty years previously, and each establishment presents little else than a repetition of the works of the others. The furnace in use is a double stack, furnished along each side with horizontal ovens, into each of which three muffles or retorts are introduced. These are constructed of refractory fire clays, and are charged, like the retorts of gas furnaces, by conveying the material upon a long charger or spoon into the interior. Their dimensions are about 4 feet long, 22 inches high, and 8½ inches wide, and the weight of the charge introduced is only about 55 pounds. The ovens on each side of the stacks contain as many as 20 and sometimes 30 retorts. The same stack contains besides, 1st, an oven in which the ores belonging to it are roasted for expelling the water and a portion of the carbonic acid they contain (a process in which they lose about ⅓ their weight); 2d, an oven for baking the retorts, each establishment making its own; and 3d, a furnace for remelting and purifying the zinc obtained from the retorts. Several stacks are arranged in a large building with close walls and open along the top of the roof to allow the smoke to escape.

The principal zinc mines are in the vicinity of Beuthen, and are found in the magnesian limestones of the new red sandstone formation. The ores lie in irregular deposits, and it is found that their yield of zinc has been gradually falling off, so that it is now only about two-fifths of what it was formerly. This low yield involves a large consumption of fuel, which is twenty tons for one of zinc obtained. The coal employed in working the ores is of poor quality, burning without flame; but it leaves no cinder, and is procured from mines very near the works, and at the extraordinary low price of six to seven francs the 1,000 kilogrammes (about one ton). The retorts are charged every twenty-four hours with roasted ore reduced to the size of nuts, and mixed with oxide of zinc from previous operations, with the dross from the crucible employed in remelting, with the incrustations from the muffles, and their connections outside the furnaces, and, in fine, with cinders that have fallen through the grates, these last making about one-third the bulk of the charge. The workmen having discharged a muffle of the liquid zinc and oxide remaining from the previous operation by drawing them forward, so that they fall upon an iron shelf placed below to catch them, and having repaired any cracks and holes in the muffle, they introduce the new charge in small portions at a time, and immediately adjust the outer connection, which is also of earthenware bent down at a right angle, and close up the openings in front. The zinc soon begins to distil over, and drops upon the iron shelf, and is mixed with oxide colored by the oxide of cadmium. When run into molds, the spelter is stated to have the following composition: zinc, 97.50; cadmium, 1.00; lead, 0.20; arsenic, 0.84; sulphur, 0.05; together with traces of tin, iron, and carbon.

Forty years ago the quantity of zinc used for roofing did not exceed 5,000 tons per annum, and no zinc was employed for sheathing ships, or lining packing cases. The stamped ornaments in this metal only came into use in 1852. In Germany zinc is now very generally used for roofing; and in Paris it has been employed for nearly every roof constructed during the last twenty-five years. In laying the sheets great care is taken that the metal has sufficient room to expand and contract by change of temperature; and especially that it is fastened with zinc nails, and is allowed to come nowhere in contact with iron—even with nail heads. The purer the metal the longer it lasts.

Besides the uses named for this metal, it is employed for coating sheet iron, making what is called galvanized iron; for pipes for conveying liquids; for baths, water-tanks, milk-pans and pails, plates for engraving; for galvanic batteries; for nails, spikes, and wire; for signs; music printing; and for the cornices of buildings. It has also been cast into statues, in imitation of bronze. The Vieille Montagne Company sent to the Great Exhibition in London a statue of Queen Victoria, which with its pedestal of zinc was twenty-one feet high. By a process somewhat like lithography, called Zincography, drawings, old engravings, and autograph letters are transferred to it, and after treatment with acids, printed from a raised surface. A modification of this process called Photozincography, accomplishes the difficult task of printing from a photograph. Zinc is also an important reagent in chemical operations, and is employed with sulphuric acid to decompose water for obtaining hydrogen gas.

## ZINC PAINT.

White oxide of zinc was first recommended as a substitute for white lead by the celebrated Guyton de Morveau about the close of the last century, during his investigations on the subject of lead poisoning; and to him it was suggested by Courtois, a manufacturer at Dijon. The high price of zinc at that time, and ignorance respecting the proper manner of using the oxide of zinc, prevented its introduction. It was many years after this that methods of producing it as cheaply as white lead were devised by M. Leclaire, a house-painter of Paris; and he also first prepared to use with it a series of yellow and green unchangeable colors, to replace those before in use having noxious bases of lead, copper, or arsenic; and also a drying oil, prepared by boiling linseed oil with about five per cent. of oxide of manganese. His process, which is still the one in general use in Europe, is based on the treatment of the metal instead of the ore, as practised in this country, and scarcely any white oxide of zinc is there made by any other method. The furnaces employed are similar to those for producing the metal, or like those of the gas works. When the retorts set in these furnaces have become very hot, they are charged with the ingots of zinc. The metal soon melts, and its vapor passes off through the outlets of the retorts, where it meets a current of air, and both together are drawn on through the condensing apparatus either by the draught of a chimney, or by an exhausting fan at the further extremity of the apparatus. The metallic vapors become oxidized by mixing with the air, and are converted into a light, flaky, white powder, which is the oxide of zinc. The arrangements for condensing and collecting this are similar in principle to those employed for the same purposes in the American process. By making use of the metal in retorts, instead of subliming it from ores contaminated with their own impurities, and mixed with the coal required for conducting the process, a much purer oxide of zinc is obtained; and by selecting the purest sorts of spelter, the beautiful article, called by the French *blanc de neige*, or "snow-white," is produced, which is employed by painters in the place of the "silver-white." With the use of other zinc, the product is fit to be substituted for the best white lead. But if the metal has been made from ores containing cadmium or iron, or if old zinc has been introduced to which any solder adheres, according to the French chemists oxides of other metals are produced, and are taken up in small quantities with the zinc vapors, imparting to the oxide a slightly yellow or greenish tint, which if not very decided may however disappear when the paint is mixed; but the experience of American manufacturers does not accord with this explanation.

The manufacture of white oxide of zinc direct from the ore is a purely American process, established by the experiments of Mr. Richard Jones of Philadelphia in the year 1850. The great bodies of the rich ores of northern New Jersey had at various times, for the past two centuries, attracted the attention of many persons interested in metallurgical operations; and of late years numerous attempts had been made to devise some method of converting them to useful purposes. Zinc, however, was a metal not much in demand, and nothing was known of the useful qualities of the white oxide. When the value of this had been demonstrated in Europe, and the practicability of producing it economically from the red oxide was shown, a company was organized in New York under the name of the New Jersey Zinc Company, for the purpose of carrying on this manufacture upon a large scale. This association was incorporated by the Legislature of New Jersey, February 15, 1849, and the report of their operations, made December 31, 1853, by their president, C. E. Detmold, Esq., showed a production, for 1852, of 2,425,506 lbs. of oxide; and for 1853, of 4,043,415 lbs.; and the total production for 10 years, ending with 1860, has amounted to above 19,500 tons. Their works were established at Newark, N. J., to which place the ores were brought by the Morris and Essex canal; and the anthracite consumed in the manufacture was delivered both by railroad and canal. The company has forty furnaces, that may be kept in constant operation. The character of the process was the same as that given below, as conducted by the Passaic Mining and Manufacturing Company.

The success of the enterprise of the New Jersey Zinc Company, and the discovery in 1853 of the great beds of silicate and carbonate of zinc in the Saucon valley, Pennsylvania, led to the organization in that year of the Pennsylvania and Lehigh Zinc Company, and the erection of furnaces for making the oxide at Bethlehem, on the Lehigh river. The operations were conducted by Samuel Wetherill, Esq., by a patented process of his own invention, and at a contract price of $50 per ton; the ore being delivered by the company at the works for $1.50 per ton. About four tons were consumed to the ton of oxide. The company mined up to January, 1860, about 60,000 tons of ore, and at that time were manufacturing about 320,000 lbs. of oxide of zinc per month.

A third company was established in 1855, called the Passaic Mining and Manufacturing Company, and their works, constructed at Communipaw, on the Morris canal near Jersey City, went into operation in June of that year. They obtained their ores both from the mines of red oxide in Sussex county, and from the Saucon valley mines in Pennsylvania. They employed 24 furnaces, built in 3 stacks, of 8 each, in which they were arranged like ovens, half of them opening on one side and half on the opposite side. Each one was about 6 feet in depth (from front to back), 4 feet in width, and about $3\frac{1}{2}$ feet in height. The roof was arched, with an opening through it for the pipe which conveyed away the vapor and products of combustion. The sole was formed of cast-iron plates, which were perforated full of small holes for admitting the blast to penetrate every portion of the charge, as the wind was driven by two large fan-blowers into the receptacle under the furnace corresponding to the ash-pit. The ores were prepared by first crushing them to powder, which was done by passing them through two pairs of Cornish rolls, and then mixing them thoroughly with about half their weight of the dust of anthracite. A fire was kindled upon the grate-bars of 250 lbs. of pea coal, and when ignited to full whiteness the charge of 600 lbs. of ore, mixed with 300 of coal dust, was added, and when exhausted the charge was withdrawn, leaving only sufficient coal to ignite the next charge, thus working off 4 charges in every 24 hours. The proportion of oxide obtained from the ore was variable, as the charge was not of uniform quality; but it was usually between 30 and 40 per cent. As the coal rapidly consumed from the effect of the blast, the ores were decomposed, and metallic zinc sublimed. The vapor rose with the gaseous products of combustion, and all were carried up the pipe, which just above the roof of the stack terminate under an inverted funnel, the base of which covered the lower pipe like a hood, and the upper portion was a pipe like that below. A strong current of air was created by two exhausting fan-blowers, at the other extremity of the apparatus, and the vapors were drawn up together with much air which flowed in around the open base of the funnel, and caused at this point a vivid combustion of the zinc vapors, which burned with a pale blue flame, and were thus converted into oxide. The appearance presented by this combustion actively going on in full view under each hood was very striking, and was far from suggesting to an observer unacquainted with the process, the possibility that from the pale flames rushing up the pipes any valuable product could be recovered. The pipes connected above with a cylindrical sheet-iron receiver that extended over the three stacks, so as to secure the products of all the furnaces. It was a huge pipe, $6\frac{1}{2}$ feet in diameter, and 130 feet long, and passed along under the roof, against a line of windows on each side, through which air was admitted for hastening the cooling of the products. The pipe discharged into a square tower in masonry, and in this the particles were washed and cooled by a continual falling sheet of water. The light flocculent oxide of zinc was not carried down by this to any great extent, but was drawn on by the exhaust through 3 large pipes to a second tower with three divisions, in which the fans were placed that created the draught. From this the current, still propelled by the fans, moved on through other pipes that connected with the system of flannel bags, which in great numbers, and of extraordinary sizes, were suspended throughout the portion of the building devoted to the final cooling of the oxide, and filtering it from the gaseous matters intermixed. Some of the bags extended the whole length of the rooms, which were 120 feet long by 64 wide, and the diameter of the largest of them was over 4 feet. They were arranged near together, and some were carried vertically from the horizontal ones up to the roof. Through the pores of the flannel the gases escaped, and the oxide of zinc remained thoroughly purified. Nearly 200,000 square feet of flannel were worked into these bags; and one person was almost constantly employed with a sewing machine, and two others working by hand, in making and repairing them. Along the under side of the horizontal bags pipes of cotton cloth, ten or twelve inches in diameter, reached down nearly to the floor, and were kept tied around their lower ends. These were called the teats; and the oxide of zinc was collected by lifting up the portions of the bags where it had settled, and shaking these so as to make it fall into the teats. The ends of these were then opened, and the white zinc was received in strong bags, which being tied up were laid upon a truck, and this was run by steam power back and forth under a compressing roller. The air dispersed through it, rendering it so light and bulky, was thus expelled, and the oxide was converted into a dense, heavy powder. The last process was to grind this with bleached linseed oil, which was done in the ordinary paint mills. The paint was then transferred into small kegs for the market.

The residuum of the furnace charge, when of red oxide, consisted of some unsublimed zinc ore mixed with franklinite and more or less unconsumed coal. It was raked out in the form of slags, and accumulated in immense piles about the works. In 1853, Mr. Detmold succeeded in using this as an iron ore, and produced excellent iron which proved to be also well adapted for the manufacture of steel. The iron manufacture has been continued, and has become a profitable branch of the operations of the United States Zinc Company, producing about 2000 tons of zinc per annum. The franklinite itself had been used a year earlier for the same purposes by Mr. Edwin Post, at Stanhope, and from this he obtained both iron and steel; but when the manufacture was undertaken upon a large scale by the New Jersey Franklinite Company, at Franklin, New Jersey, it proved unsuccessful in practice.

The product of the zinc works of the Passaic Company for the year 1856, was 2,327,-9_0 lbs. of oxide of zinc; and the monthly production for the year 1860 was about 400,000 lbs. from 16 furnaces. With the 24 in blast their monthly capacity was from 280 to 300 tons of 2 000 lbs. to the ton. The total annual product of the three establishments was from 6000 to 7000 tons of oxide.

The rate of the importations of zinc, spelter, and manufactures of zinc, with the re-exports of the same at different dates from 1859 to 1880, both inclusive. were:

| | Imported. | Exported. |
|---|---|---|
| 1859, | $1,333,112 | $14,912 |
| 1860, | 804,358 | 26,383 |
| 1862, | 254,033 | 563 |
| 1864, | 675,931 | 3,973 |
| 1866, | 1,149,895 | 38,108 |
| 1869, | 1,197,682 | 4,022 |
| 1870, | 1,003,432 | 833 |
| 1872, | 1,386,618 | 27,674 |
| 1874, | 447,844 | 27,872 |
| 1876, | 328,380 | 79,868 |
| 1878, | 129,183 | 300,606 |
| 1879, | 108,494 | 211,469 |
| 1880, | 653,390 | 163,866 |

The importance of the application of white zinc to painting in the place of white lead appears to have been much more fully appreciated in France and the United States than in Great Britain. Soon after the discoveries of Leclaire that white oxide of zinc could be thus used, and produce, with the colored bases he prepared of this and other innocuous oxides, all the tints required, the French government, recognizing the importance of his inventions, conferred upon him the cross of the Legion of Honor, and adopted the paints for the public buildings. By the year 1849, over 6000 public and private buildings had been painted with his preparations, and the testimony was very strong in their favor. Not one of his workmen had been attacked by the painter's colic, though previously a dozen or more suffered every year from it. The colors were pronounced more solid and durable than the old, were made brighter by washing, and were not tarnished by sulphuretted hydrogen, as occurs to white lead. The best white paint was moreover so pure and brilliant a white, that it made the best white lead paint by its side look disagreeably yellow and gray. No difficulty was experienced in making the new colors, mixed with the prepared oil, dry rapidly without the use of the ordinary dryers of lead compound; and used in equal weight with lead, the zinc was found to cover better, and was, consequently, more economical at equal prices per lb. The English, however, found many objectionable qualities in the new paint. Its transparency, which is the cause of its brilliancy, by reflecting instead of absorbing the light, was regarded as a defect, and the painters complained that it had not the body or covering properties of the carbonate of lead. It would not dry rapidly for the second coat without the use of the patent dryers, which contain lead, and therefore it was no better than the lead. Messrs. Coates & Co., who now import into Great Britain about 1000 tons of oxide of zinc per annum, wrote to the editor of the *Lancet* in March, 1860, that the consumption of white lead is still nearly 100 to 1 of white zinc, and that in 1856 the importation of the latter amounted to only 235 tons. They ascribe the real cause of the larger consumption of white lead, to the almost entire exclusion of zinc, to the fact, that white lead can be adulterated with barytes and other cheap ingredients without the adulteration being detected by the eye, thus securing large profits to the manufacturer and contractor, which cannot be realized in the use of zinc paint, for the reason that it has little affinity for foreign substances. The experience of the manufacturers of the United States does not substantiate this statement as to the difficulty of using the oxide of zinc in mixture with other substances. It is employed not only alone, but mixed with either barytes or white lead, or with both of them; and large quantities are thus sold and give satisfaction to consumers, who would reject the paint, if they supposed it to be any thing else than white lead. As to its covering quality, it is found that the oxide of zinc varies according to the manner in which it has been prepared. The light flocculent oxide mixes readily with oil without grinding; but though pressed, it covers much less surface than the same oxide moulded when moistened with water, and dried by artificial heat. This preparation also causes any yellowish or greenish tints to disappear, and the article may be supplied to the consumer in cakes, which when ground with oil will cover more surface than the same weight of white lead. The body of the white zinc may be still further improved by calcination before grinding.

The inferior colored sorts of oxide of zinc, such as are collected in the iron receivers near the furnaces, and that made from the pulverized ores of zinc, have been largely employed for painting iron surfaces, especially on board of ships, the paint being found to possess a peculiar quality of protecting the iron it covers from rusting.

Besides its use as a paint, oxide of zinc is applied to the preparation of the mastic for rendering metallic joints tight; and to that of glazed papers and cards, for which white lead and carbonate of barytes have heretofore been used. The French use it in preparing the paste for artificial crystals instead of oxide of lead or other metallic oxides; and they have also made with it some of the finest sorts of cut glass and especially lenses. In the Great Exhibition of 1851, an award was made to specimens of zinc glass which presented a very pleasing and white appearance, and were regarded as especially suited to achromatic purposes. It was remarkable for its being purer and more pellucid than lead glass, and also of greater specific gravity.

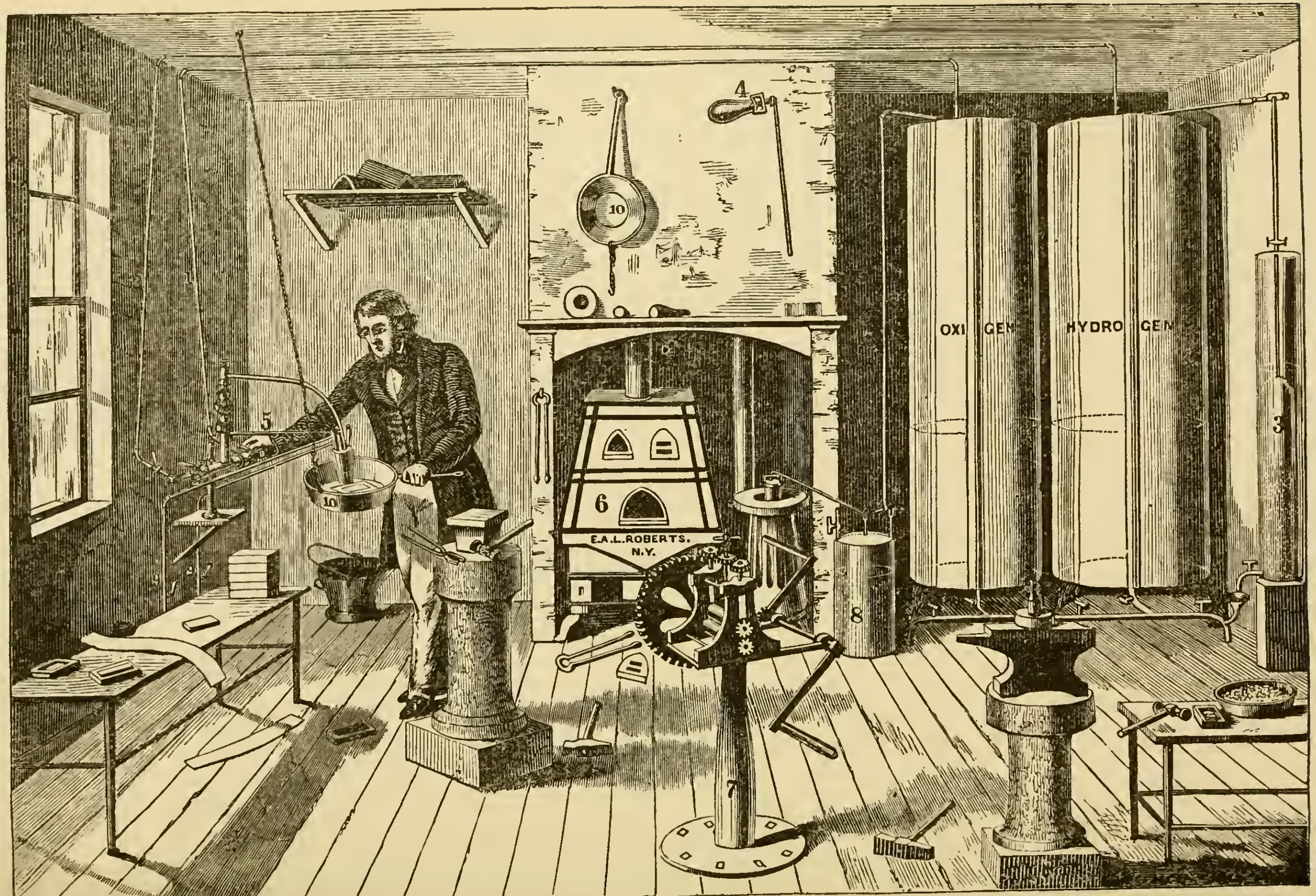
A patent has been granted in the United States for the manufacture of flint glass with oxide of zinc, and specimens of glass produced with it have been exhibited which were remarkable for their brilliancy and beautiful surface, or "skin," as it is called. The glass is more infusible than that made with oxide of lead, and there seems to be no good reason to prevent it from coming rapidly into use.

## CHAPTER VI.

### PLATINUM.

Although this metal is not obtained in large quantity in the United States, it is found associated with the gold in many localities in California, Nevada, Oregon, and Colorado, and has been detected in Rutherford Co., N. C., and in traces in ores in Lancaster Co., Penn. From the Pacific states it may yet be afforded as a commercial article. It is a metal of considerable interest, and is supplied to commerce from various sources, and finds its way into the United States in a great variety of forms, as in native grains found in washing the gold deposits of Cauca, on the western coast of South America, of Brazil, California, and Oregon, and in manufactured articles imported from Europe, and chiefly from France. Russia produced between the years 1824 and 1845 many times as much platinum as all the rest of the world, and introduced the metal into her coinage; but after 1845 it was no longer coined, and the yield of the deposits in the Ural has greatly dwindled. The supply from Borneo has been very large for some years, the whole product of the island sometimes amounting to 600 lbs. a year. It is found in small grains and lumps in the sands that are washed for gold; and pieces of several pounds have been met with in Siberia, the largest weighing over 22 lbs. troy. The importation in 1880 was about 2,140 lbs., valued at $248,600, and the home production perhaps one-third of that amount.

The properties which give to the metal its great value, as its power of resisting the effects of heat and many of the most powerful chemical agents, also render it exceedingly difficult to work and to convert into useful shapes. The crude grains are generally alloyed to the amount of about 20 per cent. of their weight with the very refractory metal iridium, with osmium, rhodium, iron, and sometimes other metals also. It is separated from the chief part of these and purified by dissolving the grains in *aqua regia*, a mixture of nitric and hydrochloric acid, and causing the metal to be precipitated by sal-ammoniac. It falls in a yellowish powder, which is a compound of platinum, ammonia, and chlorine. To decompose this the compound is separated from the liquid, and being well washed and dried, is heated red hot in a cast-iron crucible. This drives off the ammonia and chlorine, and the platinum remains in the crucible in a spongy condition. This is condensed into solid metal by repeated heatings and hammerings. It has always been a matter of great difficulty to raise


OXI GEN
HYDRO GEN
E.A.L. ROBERTS.
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10
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sufficient heat to soften the platinum, even in quantities less than an ounce, so that it could be worked under the hammer. It used formerly to be brought into a metallic cake by making a fusible alloy of it with arsenic, and then burning out the latter as much as possible, and hammering or rolling the cake into sheets, but the arsenic remaining in the platinum always injures its quality. Dr. Robert Hare, of Philadelphia, was the first to fuse the metal for any practical purpose, and in May, 1838, he exhibited a cake of about 23 ounces, which was run together from grains and scraps by means of the intense heat produced by his oxy-hydrogen blowpipe. From a reservoir of oxygen, and from another of hydrogen, a gas-pipe conveyed the gases into one tube, in which they were mixed just back of the igniting jets; and in this the explosive mixture was kept cool by ice around the tube. Explosion was moreover guarded against by the extreme fineness of the apertures through which the gases were made to pass.

This means of working platinum was applied by Dr. E. A. L. Roberts, formerly of Bond street, New York, in the preparation of platinum plate and various articles in this metal employed by dentists, such as the plates and fastenings for sets of artificial teeth, and the little pins which secure each tooth in its setting. The annual consumption of these last, it is estimated, amounts throughout the United States to about $60,000 in value, which is nearly one-fifth of the annual supply of the metal. The apparatus consists of two cylindrical copper gas-holders, one for hydrogen, holding 220 gallons, and one for oxygen, holding 80 gallons. The Croton water, with a pressure of about 60 lbs. upon the square inch, is admitted into the bottom of these gas-receivers, for propelling the gases as they are required. The discharge pipes have each at their extremity a short brass tube, which is full of pieces of wire of nearly the same length as the tube, jammed in very tightly. These unite in another brass tube which is packed in a similar way, and connects by a metallic pipe of only ¼ inch bore, with the burner. This is a little platinum box, one end of which terminates in a disk of platinum or copper ½ by ¼ inch in size, perforated with 21 very minute holes in 3 rows. This box is buried in plaster of Paris mixed up with fibres of asbestus, forming a lump sufficiently large to contain around the box a receptacle into which, by means of flexible pipes, a current of water is admitted and discharged on the same principle that the water-tuyeres of iron forges and furnaces are constructed and kept cool while in use. The burner points downward, so that the jet is directed immediately upon the face of the metal held up beneath it. The method of using the apparatus is as follows: the platinum scraps being first consolidated by pressure in moulds into compact cakes of 10 to 20 ounces each, these are placed upon a plate of fire-brick, and brought to a full white heat in a powerful wind furnace. The plate with the platinum is then removed from the furnace and set in a large tin pan thickly lined with asbestus and plaster of Paris, and is brought directly under the jet, which at the same time is ignited. The platinum immediately begins to melt upon the surface, and the pieces gradually run together into one mass as the different parts of the cakes are brought successively under the jet. Though the metal melts and flows upon itself, it cools too rapidly to be cast in a mould; nor is this necessary or desirable for the uses to which it is applied. These require a soft and tough material, while the fused metal is hard and sonorous, and of crystalline texture, breaking like spelter. It is made malleable and tough by repeated heatings and hammerings. It is introduced into the muffle of the assay furnace constructed by Dr. Roberts especially for producing the high heat required in these and similar operations, and is heated so intensely that when the door of the furnace is opened the cake of metal is too dazzlingly hot to be visible. It is then taken out with tongs plated with platinum, and hammered with a perfectly clean hammer upon a clean anvil, both of which should be as hot as possible without drawing the temper of the steel. If the process is one of welding, when the platinum has cooled so as to be distinctly visible, it should be heated again, for in this condition every blow tends to shatter and shake it to pieces. The lump is forged by hammering it to a thickness of about ¼ of an inch, and then being again heated very hot, is passed instantly through the rolls. It is thus obtained in sheets, which are easily converted into the various uses to which the metal is applied.

Upon the opposite page, the apparatus employed and manner of conducting the operations are exhibited in the wood cut;

and the articles designated by the figures are thus explained:—

1. Reservoir for oxygen.
2. " " hydrogen.
3. Hydrogen generator.
4. Oxygen "
5. Blowpipe.
6. Tuyere.
7. Rolls for converting the metal into sheets.
8. Gasometer.
9. Water pipes.
10. Pan.
11. Moulds in which the loose pieces of metal are compressed.

Crucibles for chemical use are prepared by the ingenious method called spinning. A disk of the metal is securely fixed against the end of the mandrel of a lathe, and, as it revolves rapidly, a blunt point is pressed upon its surface, causing the plate to gradually bend over and assume the desired form. The large platinum retorts used in the manufacture of sulphuric acid are imported from Paris. One of them of sufficient size for a five-ton still weighs from 60 to 65 lbs., and is worth from $6,200 to $6,800. The value of platinum imported into the United States for the year 1880 was $248,674. The native product was certainly sufficient to bring the total amount considerably above $320,000 a year.

### IRIDIUM AND OSMIUM.

An alloy of these metals in fine grains of excessive hardness is found very frequently with platinum and with the gold which is refined at the mints. It is of interest from the use to which it is applied in forming the nibs of gold pens; and for this purpose the small grains are purchased by the pen-makers, sometimes at the rate of $250 an ounce. From this quantity they may select from 8,000 to 12,000 points of suitable size and shape for use. The alloy is known as iridosmine, and is also very generally called iridium. At some seasons it has been quite abundant in the gold presented at the New York assay office; but recently it is more rare. As it does not fuse and alloy with the gold, it appears in specks upon the bars of this metal. The method of separating it is to melt the gold with a certain portion of silver, as in the usual refining process. The alloy thus obtained being less dense than the melted gold, the particles of iridium settle in the lower portions; the upper is then ladled off, and the metals are parted. More of the impure gold is added, and the process thus goes on till a considerable amount of iridium is concentrated into the alloy of gold and silver, from which it is at last obtained by dissolving these metals. According to the statement of Dr. Thèvenet published in the *Annales des Mines* (vol. xvi., 1859), iridium is collected at the gold-washings along the sea-coast of Oregon, and is sometimes quite equal in quantity to the gold. He describes it as white, glistening, very heavy, its specific gravity being 20 to 21, very hard, and resembling sand, its angles slightly flattened and rounded by friction. It is accompanied by platinum and rhodium. After one of the storms that prevail along this coast, the miners at low tide collect the black sand and carry it to the washing and amalgamating apparatus, in which it is stirred with mercury and then treated upon the shaking tables. Though by their rude processes they probably lose ⅕ of the precious metals, they sometimes collect several ounces a day of gold to the man. Near Fort Orford, to the north of Rogue River, about 15 per cent. of iridium is found with the gold. Still further north, between Cape Blanco and Coquille, the metals collected consist of about 45 per cent. iridium and 5 per cent. platinum. Between Randolph and Cape Arago the metallic grains are very light and in extremely thin scales; they consist of 70 per cent. iridium and 6 per cent. platinum. Further north, the iridium continues almost as abundantly, but mostly in very fine particles. One piece was shown to Dr. Thèvenet as a great curiosity which was as large as a grain of rice. In sifting more than 50 lbs. of iridium, he states that he had not seen a single specimen of one quarter this size.

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## CHAPTER VII.

### MERCURY.

This metal, which is extensively employed in the arts, especially in the treatment of gold and silver ores by amalgamation, in the combination of amalgams for coating mirrors, etc., in the construction of barometers and thermometers, and other philosophical instruments, in the manufacture of the paint called vermilion, for several medicinal preparations, and for a variety of other purposes, was not classed among the productions of the United States until after the acquisition of California, when mines of its principal ore were opened, which have been extensively worked, as will be described below. Mercury, which is the only fluid metal, is found both in a native state, dispersed in drops among the slates that contain the veins of its ores, and also occurs in combination with sulphur in the ore called cinnabar, a compound of one atom of mercury and one of sulphur, or of 86.2 per cent. of the former, and 13.8 per cent. of the latter. Some other natural compounds are known, which are not, however, of much importance. Cinnabar is almost the exclusive source of the metal. This is a very heavy, brilliant ore of different shades of red; is readily volatilized at a red heat, giving off fumes, when exposed to the air, both mercurial and sulphurous; but in tight vessels it sublimes without decomposition, and if lime or iron be introduced with the ore into retorts, the sulphur is retained in combination with the new element, and the mercury escapes in vapor, which may be condensed and recovered in the metallic state. On this principle the process for collecting mercury is based. The ores of mercury are found in almost all the geological formations, but the productive mines are only in the metamorphic or lowest stratified rocks, and in the bituminous slates of the coal measures.

In order to appreciate the importance of the mines of California, it is necessary to understand the extent of the demand for this metal, and the sources which have supplied it. From the time of the ancient Greeks and Romans, mercury has been held in high estimation, and has been furnished from the same mines, which have ever since produced the chief part of the product of the world. Pliny states that the Greeks imported red cinnabar from Almaden in Spain, 700 years before the Christian era, and in his own time it was brought to Rome from the same mines to the amount of 700,000 lbs. annually. In modern times the production amounts to 2,700,000 to 3,456,000 lbs. per annum, and is chiefly obtained from two veins, one about 2 feet, and the other 14 feet thick, which, meeting in a hill about 125 feet high, spread out to a thickness of nearly 100 feet. The ores are of small percentage, yielding about $\frac{1}{10}$ only of mercury. The greatest depth of the workings was only about 330 yards several years ago. After the metal has been extracted from the ores, it is packed in iron bottles or flasks holding 76½ lbs. each, and is taken to Cadiz for shipment. For many years past, the lessees from the Spanish government, in whom the title is vested, have been the Rothschilds and other bankers of Europe; but their contracts with the government have varied from time to time, thus affecting the price at which the product was held.*

The mines next in importance have been those of Idria in Carniola, belonging to the Austrian government. These, for some years previous to 1847, had produced an annual average of 358,281 lbs. of mercury, and since that time, the production has varied, sometimes reaching 600,000, and even over 1,000,000 lbs. per annum. The other mines of Europe do not probably produce 200,000 lbs. On the American continent many localities of the ores have been worked to some extent; but although the consumption is very great at the silver mines of Mexico, amounting, as estimated by Humboldt, to 16,000 quintals of 200 lbs. each, three fourths of the supply was then derived from the European mines. In 1782, mercury was even brought to South America from China, where it was formerly largely extracted in the province of Yunnan. Yet in the early years of the Spanish conquest Peru was a large producer of the metal, its most important mines being in the province of Huancavelica, where no less than 41 different localities of the ore have been known; but at present the whole product of the country is supposed not to exceed 200,000 lbs. A large portion of this product is from the Santa Barbara, or the "Great Mine," which has been worked since 1566. The mines of Chili and the numerous localities at which the ores have been found in Mexico supply no metal of consequence. Dumas estimated, twenty-five years ago, the total annual production as follows:—

| | Lbs. avoirdupois. | | |
|---|---|---|---|
| Almaden, Spain, ........ | 2,700,000 | to | 3,456,000 |
| Idria, .................. | 648,000 | " | 1,080,000 |
| Hungary and Transylvania, | 75,600 | " | 97,200 |
| Deux Ponts,............ | 42,200 | " | 54,000 |
| Palatinate,.............. | 19,400 | " | 21,600 |
| Huancavelica........... | .. | " | 324,000 |
| California,............. | .. | " | 2,000,000 |
| Total, ........................ | | | 7,032,800 |

* In 1839 the royalty demanded by the government was $59 per quintal of 106 pounds, to which it had reached by successive advances from $51.25; and in 1843 it had advanced to $82.50 per quintal. The opening of the California mines soon caused this to be considerably reduced. In 1880, the price at which mercury is sold in small quantities is forty-two cents a pound, or $30 the iron flask of seventy-five pounds—only about one-half of the royalty demanded by the Spanish government in 1843.

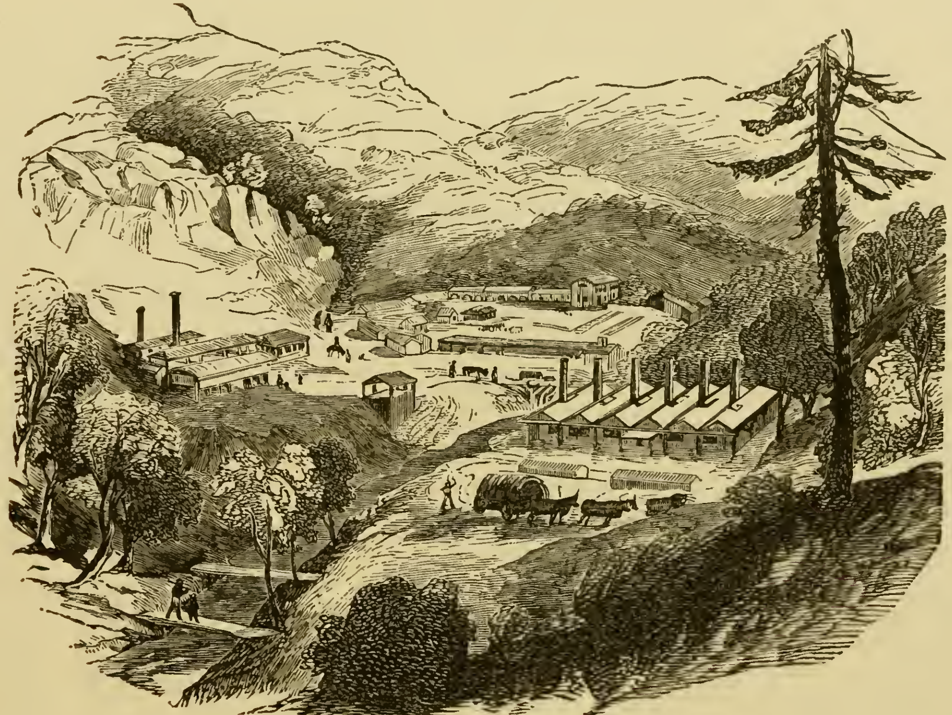
In California, the existence of large quantities of cinnabar was known long before the real character of the ore was understood. It was found along a range of hills on the southern side of the valley of San José, about sixty miles southeast from San Francisco. For an unknown period the Indians had frequented the locality, coming to it from distant places, even from the Columbia river, to obtain the bright vermilion paint with which to ornament their persons. With rude implements, such as the stones they picked from the streams, they extracted the ore from the flinty slates and shales in which it was found, and in their search for it they excavated a passage into the mountain of about sixty feet in length. In 1824 the attention of the whites began to be directed to this curious ore, and some of the Mexicans sought to extract from it gold or silver. Other trials made of it in 1845 resulted in the discovery of its true character, and operations were thereupon commenced to work it by one Andrés Castillero. Owing however to the disturbed state of the country, little was done until 1850, when a company of Mexicans and English engaged vigorously in the extraction and metallurgical treatment of the ore, and established the mine which they called the New Almaden. In 1858, a stop was put upon their further proceedings by an injunction issued by the United States court on the question of defective title. From the testimony presented in the trial, it appeared that the company in the course of eight years had produced full 20,000,000 pounds of metal, and realized a profit of more than $1,000,000 annually. The Americans who claimed the mine directed their attention to the discovery of new localities of the ore, and succeeded in finding it upon the same range of hills, within less than a mile of the old workings. Here they opened a new mine in December, 1858, which they named the Enriquita, and in June, 1860, a company was formed in New York for working it under the name of the "California Quicksilver Mining Association."

The litigation in regard to the New Almaden mine extended to the Enriquita and the other mines of the vicinity, and for a period of nearly ten years the production was so much obstructed by these lawsuits that they were unable to demonstrate their full capacity. Eventually the Enriquita mine was merged in the group of New Almaden mines, and has now no separate or independent existence.

The operations at the Enriquita mine were carried on from the face of the hill, some five or six levels, one above another, being carried into the mountain up and down its slope. The most extensive of these was the adit level at the base, which is about 600 feet long. Shafts are sunk from this to the depth of about fifty feet; but the principal workings were in the upper levels for 300 feet over the adit. These were exceedingly irregular, owing to the unequal distribution of the ore through the argillaceous slates. With the cinnabar was intermixed some arsenical iron and copper pyrites, and the ore and slates were both traversed by veins of carbonate of lime, some of which are retained in hand specimens of the cinnabar.

On the same range of hills, at its western extremity, the Santa Clara Mining Company, of Baltimore, opened a mine called the Guadalupe.

The Redington and the San Juan Bautista mines, on the same range of hills, have also been very profitable; while the New Idria mine, in Fresno county, though for a long time embarrassed by litigation, has, since the lawsuits were terminated, in 1865, yielded a larger amount of quicksilver than any other, except the New Almaden mine. The production of the mines we have named, since the opening of the New Almaden mine, in June, 1850, to the present time (1882), has considerably exceeded one hundred million pounds. There are now about sixty quicksilver mines worked in California, as the whole central portion of the Coast Range is full of cinnabar; but many of these are of small capacity of production. There are seven or eight smelting works. The present annual production is not far from 12 million pounds, of which our annual exports, since 1876, have been about 3,500,000 pounds, though the constant opening of new gold mines has greatly increased the home demand. Our present production is nearly double that of the world in 1855, but the demand has likewise doubled. Should this great demand still increase in the same ratio, it will be found desirable to open quicksilver mines in Nevada, Arizona, and Utah, where there are known to be large deposits of cinnabar.



NEW ALMADEN QUICKSILVER MINE.

### METALLURGIC TREATMENT.

From cinnabar not contaminated with strange metals, the method of obtaining the fluid mercury is very simple. In the early workings of the New Almaden mine, the clean ores were placed in the common "try pots," such as are used by the whalers, and a cover being tightly luted on, a fire was started under them, and the mercurial vapors escaped through a tube inserted in the lid and were condensed in cold vessels. Afterward furnaces were constructed in brick-work upon a large scale, each one provided with a chamber or oven 7 feet long, 4 feet wide, and 5 feet high, corresponding to the chamber of the reverberatory furnaces; and into this was introduced a charge of 10,000 lbs. of clean ore separated from the poorer portions after the whole had been broken up. With the ore was mixed a portion of lime to combine with and retain the sulphur. A partition of brick-work separated the oven from the fire-room, and the bricks in this partition were so laid as to leave open spaces for the flame from the burning wood to pass through. On the opposite side of the oven another partition separated this from a chamber of its own size, the only communication between them being by a square hole in one of the corners close to the roof. This chamber connected with another by an opening in the opposite corner near the floor, and this arrangement was extended through eight chambers. Between the last one and the tall wooden flues through which the smoke and vapors finally passed out into the open air was placed a long wooden box provided with a showering apparatus. As the cinnabar was volatilized by the flame playing over the charge, the vapors were carried through the condensing chambers, depositing in each a portion of mercury, and in the showering box they underwent their final condensation. From the bottom of each chamber the metal flowed in gutters to the main conduit which led to the great iron reservoir sunk in the ground. From this it was poured into flasks through brushes which intercepted the scum of oxide of mercury. The method proved very wasteful, from the leakage of the vapors through the brick-work; and it has been abandoned for an improved process, in which the pulverized ores mixed with quicklime are charged into large cast-iron retorts very similar in their form and setting to those employed at the gas-works. Three are set together in a bench of brick-work, and each one is furnished with an eduction pipe inserted in the end and leading down into water contained in a large cylindrical condenser of iron. This is placed along the front line of the furnace, so as to receive the vapors from all the retorts. The mercury, as it is condensed, falls down to the bottom, and is let out through a pipe by a contrivance that prevents the water flowing with it from the condenser.

In conducting the furnaces, the workmen are seriously affected by inhaling the mercurial vapors. They are sometimes even salivated, and are often obliged to abandon the business for a time. The horses and mules also suffer from the noxious fumes, and many are lost in consequence. But no injurious effects are experienced among those employed in the mines, the cinnabar being always handled with impunity.

### USEFUL APPLICATIONS OF MERCURY.

The principal uses to which mercury is applied have already been named. More than nineteen-twentieths of the whole product is consumed in the various processes for the reduction of gold and silver ores. The quicksilver is now applied in various ways, according to the character of the ores or placer deposits, and a larger proportion of it is saved than formerly. In the amalgamation, it often happens that the quicksilver becomes "floured," or divided into very minute globules, and in this condition it cannot regain its liquid or even its pasty form, from the fact that it has become combined with some of the baser metals, and it is carried off in the pulpy tailings and is lost. This loss involves more than the mere loss of the quicksilver, though that is considerable, for these minute globules are generally very fully charged with the precious metals, which they have been taking up. The new methods of treating the tailings enable the miners to regain a considerable portion of the quicksilver and the gold with which it has formed a union; and this desirable result is greatly facilitated by adding a minute quantity of *amalgam of sodium*, which causes the quicksilver to resume its liquid form instantly.

The principles of the amalgamating process are explained in the account of the treatment of gold ores. In the arts amalgams are applied to many useful purposes, of which the most important is coating the backs of looking-glass plates with tin amalgam. Silver was originally employed instead of tin, and the process is still called "silvering." It is conducted at several establishments in the United States on the old Venetian plan, which has been in use for 300 years. The process is a simple one, but is attended with some difficulties arising from the imperfections which will sometimes appear upon the coating, notwithstanding the particular care taken to avoid them. The health of the workmen also suffers, so that they cannot pursue the business more than a few years. The only precaution taken to protect them from the effects of the mercury is thorough ventilation. Frequent use of sulphur baths also is very beneficial. The method of silvering is as follows: tables are prepared of stone made perfectly smooth, with grooves sunk around the edges. These are set horizontally, but can be raised a little at one end by a screw. Each table is covered with tinfoil carefully spread out over a larger surface than the plate will cover, and slips of glass being laid around three of the sides, the mercury is poured on till it covers the foil to the depth of about one-fourth of an inch. Its affinity for the tin, and, the slips of glass, prevent its flowing off. The glass plate rendered perfectly clean is then slidden along the open side, the advancing edge being kept in the mercury, so that no air or oxide of the metal can get between the plate and the amalgam. The plate, when in place, is secured and pressed down by weights laid upon it, and the table is raised a little to allow the excess of mercury to trickle off by the grooves and collect in a vessel placed on the floor to receive it. After remaining thus for several hours, the plate is taken off and turned over upon a frame. After several weeks the amalgam becomes hard, and the glass may then be set on edge.

The unpleasant effect of the mercurial vapors upon the workmen in this process have led many of the best manufacturers of mirrors to return to the old practice of coating the mirrors with silver, which by newly-devised processes they are able to do with great success, and produce much better effects than it was possible to do with quicksilver.

Amalgams of the precious metals are used for what are called the water-gilding and water-silvering methods of gilding and silvering applied to buttons and various other metallic articles. These, being made chemically clean, are washed over with the amalgam contained in a large excess of mercury, and are then placed in a furnace and heated till the mercury is driven off by the heat, leaving a thin film of the precious metal, which may then be burnished.

Quicksilver, or mercury, is used in many medicinal preparations, though not as profusely as formerly. The forms used in medicine are, for internal administration, the mercuric and the mercurous chlorides (corrosive sublimate and calomel), the former in very small doses, and mainly for its alterative effect, the latter often in larger doses, and with a view to the production in a moderate degree of that form of general mercurialization known as salivation, in order to overcome some constitutional affection; "blue mass," or "blue pill," a subdivision of the mercury into very minute particles by long-continued trituration with confection of roses and liquorice root, and mercury with chalk, or "gray powder." These are mild in their effect, but are liable, if long continued, to produce salivation. The mercuric iodide (red iodide of mercury), and the mercurous iodide (yellow iodide of mercury), are given more rarely, and both in small doses. The mercuric cyanide (cyanide of mercury) is also given, though rarely, and in minute doses. The preparations for external use are mercurial or blue ointment (metallic mercury rubbed very thoroughly with lard or suet); a solution of mercuric oxide in oleic acid is a more recent and elegant preparation to accomplish the same purpose. Mercuric oxide and ammoniated mercury (white precipitate), are used as gently irritant applications for sluggish sores, while cinnabar (red precipitate) is made up into an ointment, and is used, as is the mercurous oxide (black oxide) for "fumigation" in some diseases, to bring the patient more readily under the mercurial influence. Citrine ointment, containing nitrate of mercury, is used for the same purpose as the white precipitate ointment. An acid solution of the mercuric nitrate is sometimes used as a powerful caustic; and the yellow sulphate (turpeth mineral) is a prompt and non-nauseating, but rather dangerous emetic. Poisoning from corrosive sublimate (mercuric chloride), whether accidental or intentional, should be treated at once by white of eggs, or milk in large quantities, and this followed by an active emetic of ipecac, lobelia, or whole mustard.

## CHAPTER VIII.

### SILVER—COBALT—NICKEL—CHROMIUM—TIN.

The production of silver in the United States before 1859 had been very small; a few thousand dollars' worth had been obtained from the Washington mine, in Davidson county, North Carolina, and less than $500 from all the other mines east of the Mississippi river. Arizona had some silver mines, but there was so much trouble with the Indians and outlaws there, that very little of it reached the mint, or the eastern cities. The California gold contained about an average of twelve per cent. of silver, but as the U. S. standard gold coin contained eight and a half per cent. silver there was comparatively little extracted from that source. Aside from this silver parted from gold, it is doubtful if more than $100,000 of silver had been mined in this country from its first settlement. This is the more remarkable, since Mexico had produced vast quantities of silver from its first discovery, and there is now abundant evidence that silver ores had been mined extensively in New Mexico, Arizona, and to some extent in Arizona and Utah before they became United States territories.

The fact seems to have been that the early miners did not know silver ores when they saw them, and eagerly engaged in placer and quartz mining for gold. They regarded the heavy black stones which they found in their sluices as not only worthless, but as hindrances to successful mining. There are many stories on this subject, but perhaps the best, because the truest, is that in relation to the discovery of the Comstock Lode, the great silver deposit of Nevada. It is vouched for by J. Ross Browne, at that time U. S. Mining Commissioner in the west, and by Henry Degroot, a western magazine writer:—

The sides of the Virginia range of mountains in Nevada are furrowed by many deep ravines. Two of these, named respectively Gold and Six-Mile Cañons, afforded, as early as 1849, a considerable amount of placer-mining. In the spring of 1858, the miners working in Six-Mile Cañon found their rockers clogged with particles of a dark-colored mineral, which, on account of its weight, it was difficult to separate from the gold. This "black stuff" consisted of small pieces of rich sulphuretted silver ore (sulphide of silver and lead) that had been detached from the Comstock Lode, which crossed the ravine a short distance above. Being ignorant of its value, these men threw away this material with the tailings. Among these pioneer miners was an elderly man who called himself James Fennimore. His associates first contracted this into "Old Finny," and afterwards, as he hailed from Virginia, into "Old Virginny." This old man set about examining the croppings from which the cañon below had been enriched. These, being much decomposed, were found to contain a good deal of free gold, and on the 22d of February, 1858, he proceeded to take up a "claim" along them. This claim covered a portion of what is now the Mexican and Ophir grounds, at one time the most productive section of the Comstock Lode. It was not, however, until the following spring (1859) that the character of the deposits at this point became fully known. It was found that this stratum of decomposed ore was not only very rich, but that it extended to a considerable depth beneath the surface, and at once the belt of croppings on both sides of this spot were taken up for a long distance along the ledge. But even at this time it was the gold deposits they were after, and it was some little time before its value as a silver-bearing lode was known.

Some other miners had recognized the presence of silver in that vicinity, but not being on the lode, had deemed it of less value than the gold. When it became certain that there were silver ores of considerable value there, one of "Old Finny's" associates, Henry P. Comstock, offered to purchase his claim, tendering him, in part payment, an "old bob-tailed Indian pony," and the balance in whiskey. The old man accepted the offer, and made over to Comstock a property which, a year later, sold for more than a million of dollars. But Comstock himself had no appreciation of its real value, and soon after disposed of his interest in it for $5,000 or $6,000. In this second sale the claim was described as the "Comstock ground," and the name adhered to the whole lode. This Comstock lode is regarded by metallurgists as a single lode or true-fissure vein, though of extraordinary width and extent, but the ore bodies, or "bonanzas," as they are called, are so irregular in their occurrence that Professor LeConte, of California, describes it "as rather a broad metalliferous belt or ore-channel, carrying a congeries of subordinate lodes, bunches, and chimneys of ore, all reposing in as many distinct clefts, separated by "horses"* and dikes of porphyry, belts of quartz, seams of clay, making up a body of vein-matter unparalleled for magnitude and complexity in the history of mining." The geologists pronounce it a tertiary lode, of later geologic age than the Miocene epoch.

The ores of this lode are various in character, as they are anomalous in their modes of deposition. They consist principally of native gold, native silver, vitreous silver ore (argentite), stephanite, and argentiferous galena imbedded in a quartz gangue; but besides these there occur ruby silver, horn silver, polybasite, pyrargyrite, and sternbergite; iron and copper pyrites, zinc blende, and several carbonates and sulphates. The carbonates of silver and lead seem somewhat more plentiful in the lower levels of these mines, and in some of the other silver mines of Nevada they predominate. It has been a characteristic of the mines on this lode, that the greatest wealth of each mine was not found in the regular development of the vein, but in irregular masses, generally somewhat lenticular in form, but of uncertain extent and productiveness. These productive masses, variously designated as bonanzas, ore-bodies, ore-chambers, chimneys, zones, etc., have been struck as often in mines which had previously been apparently so barren as to be on the point of being abandoned, as in the more productive mines. There have been so many changes and vicissitudes, and it has been so often the case that a largely-productive mine has suddenly ceased to yield enough to pay expenses, or that an unproductive mine suddenly blossomed out into immense wealth, that, notwithstanding the immense labor bestowed upon the lode, and the vast product obtained, it has seemed to be in many respects only a gigantic lottery.

The Comstock lode has had its remarkable periods of depression and recovery; and these have alternated from its discovery to the present time. The product of 1860 was about $100,000 in bullion, of which not quite one-half was silver; in 1861 it had risen to $2,000,000; in 1862, to $6,000,000; in 1863, to $12,400,000; in 1864 and 1865, to $16,000,000 each year. In 1866 it began to fall off, and though the next year the new developments in the Consolidated Virginia and California kept up the product to almost $14,000,000, it again fell away, touching $7,500,000 in 1869, and rising again gradually till 1873, when it rose suddenly to $23,250,000, and nearly the same in 1874; to nearly $25,000,000 in 1875, and to $37,000,000 in 1876. In 1877, the amount was a little over $37,000,000, but in 1878 it fell to $21,295,030; and in 1879 to $8,830,562. In 1880, the yield was $5,-312,502, and in 1881 it did not exceed $2,000,000.

Some of these mines are very deep, the lowest levels being 3,000 feet or more below the surface. As there has been unquestionably in the past some volcanic action in connection with the depositing of the precious metals in these lodes, there are still, as Clarence King, the learned chief of the Geographical and Geologic Bureau, declares, unquestionably the lingering traces of solfataric action in these mines; the temperature at the extreme depths is 156° F., and the water which pours into the lower levels is heated almost to boiling; the miners, though wearing the smallest minimum of clothing, cannot continue operations more than fifteen or twenty minutes at a time without cooling off before resuming work. Great efforts have been made to improve the ventilation, and with some success. The Sutro tunnel, which helps to ventilate and to drain the upper levels, enters the mines at a point too high to drain the lower levels, without extensive and costly pumping. It will, however, reduce the expenses of further mining in some degree. It remains to be decided whether these lower levels of the mines, which seem to yield richer ores than those immediately above them, must be

* "Horses," in the miner's phraseology, are masses of porphyry or hard slate, which completely stop and bar any progress in working a vein, till they are cut through. They may extend several feet or yards.

abandoned because of the enormous expense of time, labor, and money involved in working them, the vast amount of waste rock and of dead weight which must be hoisted from 2,700 to 3,000 feet daily—computed to be not less than 20,000 tons—the 10,000 tons of water which must be pumped up every day, and the very short hours which are necessary to preserve the lives of the miners. The total bullion production of the mines on this lode, from 1859 to the close of 1881, is about $310,000,000, of which $189,500,000 was silver, and $120,500,000 gold.

But there are other productive silver mines in Nevada besides those of the Comstock lode. Of the 125 millions of bullion output from the mines of the state, outside of Storey county, more than one-half has been silver—generally reduced from argentiferous galena, though in some of the mines there is a predominance of the carbonates, and in some zinc and copper take the place of lead. The silver ores of Nevada do not seem to be difficult of reduction.

Of the other states and territories which produce silver, Colorado is now taking the lead, though prior to 1871 she had sent to market less than one million dollars of silver. In the eleven years to the close of 1881 she had mined and reduced over 63 millions of silver and about 46 millions of gold. The most remarkable of her silver districts is Leadville, in Lake county, known for a long time as "the Carbonate Camp." This region had been worked for a long time for placer gold deposits, and some quartz veins had also been explored and taken up, but it was not till 1877, that discoveries were made which indicated that the superficial deposits of carbonate of lead and silver were more wonderful than anything yet brought to light in the history of mining. The ore was of a new kind, a carbonate of lead, rich in silver, and required new processes, though not difficult ones, for its reduction; but there was something more remarkable than this; the first discoverers thought they had surely discovered a true fissure-vein of extraordinary width and richness; but when other miners staked their claims right by their side, and all of them found the same quality of ore extending over their claims, it began to be evident that this was not a true fissure-vein. What then was it?—not a placer, for there were strata of rock above and probably below. For want of a better name, they called the new formation a *contact lode;* it was really a blanket of lead-silver ore lying between two conformable strata. It was tolerably thick, but, though the dip of the strata was considerable, they could and did reach the underlying rock. Was there a repetition of these ore-blankets between the strata below? In some instances there seems to have been. Nearly forty millions of silver have been sent to market from Lake county in the five years 1877–81, and the next county north (Summit) has two mining districts of similar formations, which are already yielding silver in large quantities. But Colorado is a land of wonders to the miner. He finds his old notions in regard to mining all exploded; the silver ores are new and strange, and their conditions are without precedent. The silver is found native as horn silver (a chloride), as ruby silver (a red translucent ore), as carbonate, oxide, telluride, sulphide, in combination with gold, lead, zinc, copper, tellurium, iron, or tin; it forms the crust of boulders, or is infiltrated in the boulder itself; it requires as many different processes for its reduction as there are ores. Two-thirds of the counties of the state produce either silver or gold, or both, and new discoveries are constantly being made. The western counties seem to be about equally productive of gold and silver; the proportion of the two metals in the state is now about twelve of silver to nine of gold.

Utah comes next in silver production; most of the mines of southern Utah being silver, and her gold product being very moderate. There are mines and mining companies in nearly every county of the territory, and the entire mining product has been over fifty millions, and is increasing. In 1880, it was $6,450,953, and in 1881, $7,311,288. Of this product, certainly forty-eight millions were silver. Arizona and Montana are about equal in their silver production, though Montana has produced ten times as much gold as silver, and Arizona only half as much. With a firmer government and fewer Indian troubles, Arizona is increasing her production, the bullion yield of 1881 being double that of 1880. Montana is also increasing, but not rapidly. The silver product of Arizona, from the first, has been probably not far from thirty millions, and that of

Montana about twenty-two millions. New Mexico has only recently begun to develope her mines, which are mostly silver, though gold mines are not wanting in this territory so abundant in mineral wealth. Her present bullion product does not quite reach a million a year, but it will in a few years rival some of the older territories and states. She has probably contributed since her connection with the U. S. about fifteen millions to the silver stock. The production of silver in California is increasing. A number of the new mines in southern California are silver; and while her gold product hardly holds its own, the silver product is doubling. Michigan produces very little gold, but her copper and lead mines have yielded considerable silver, separated from the baser metals. The gross product of silver, from the first, probably exceeds five millions. Idaho, whose gold mines have yielded very freely, is now increasing her silver production, several very rich silver mines having been opened the past year. Oregon and Washington, as well as Dakota, produce but little silver, though some new silver mines in the Black Hills promise very fairly.

The total silver product of the United States to the close of 1881 may be stated in round numbers at $556,000,000. The product of 1881 was $45,077,828, an amount only exceeded in 1877, when it reached a little more than $47,000,000. A much greater weight of silver is used in the arts than of gold; it is largely in demand for solid silver plate, electro-plate, watches, and other articles of use or ornament. The Director of the Mint, in his report for 1881, estimates the annual consumption of silver for these purposes at $3,388,421, but his estimate is, we think, considerably below the truth.

### COBALT.

The ores of this metal are of rather rare occurrence, and are applied to practical purposes not to furnish the metal but its oxide, which is of value for its property of giving a beautiful blue color to glass with which it is melted, and of producing other fine colors when mixed with some other substances. The ores are sought for all over the world for the supply of the British and American manufactories of porcelain, stained glass, etc. They are chiefly combinations of cobalt with arsenic, sulphur, and sometimes with nickel and iron. The compound known as smaltine, or arsenical cobalt, was obtained at Chatham, Conn., as far back as 1787, and the mine has been worked for cobalt, at different times, in the present century. The cobalt in the ore is associated with about an equal amount of nickel, and its proportion is said to have been less than two per cent. Cobaltine, which is a compound of sulphur 19.3 per cent., arsenic 45.2, and cobalt 35.5, is the most productive ore of this metal, but it is not met with in this country. Varieties of pyritous cobalt have been found in Maryland in quantities too small for working; and also at Mine la Motte, in Missouri, associated with a black earthy oxide of cobalt and black oxide of manganese. It is produced now, also, at the Gap mine, in Pennsylvania. In other places, also, oxide of cobalt, in small quantity, is a frequent accompaniment of manganese ores. Mine la Motte has furnished a considerable amount of the cobalt oxide, but the beds in which it is found are not of permanent character, and are so far exhausted as to be no longer worked with profit. A similar ore, accompanied with nickel, appears to be very abundantly distributed among the talcose and quartzose slates in Gaston and Lincoln counties, North Carolina. It is thrown out with a variety of other ores, as galena, blende, titaniferous iron, etc., in working the gold mines of this region; and it is mixed among the great beds of hematite, found in the same district, which are the product of the decomposition of beds of pyritous iron. In some places it is so abundant that the strata containing it are conspicuous where the roads pass over them, by the blackness of the gossan (decomposed ore) or wad. Prof. H. Wurtz, who describes these localities (see "American Journal of Science," 2d series, vol xxvii., p. 24), is of the opinion that the earthy oxide of cobalt is the gossan of the sulphuret of this metal, existing unaltered in the rocks below. Cobalt is also found in moderate quantities in the Lake Superior mines.

Oxide of cobalt, obtained in a crude state from the washed arsenical ores, is known as zaffre or safflower, and in this condition it is a commercial article. It is refined by separating the arsenic, iron, and other foreign substances, by precipitating them from the solution in hydrochloric acid; and the oxide is finally obtained by precipitating with chloride of lime, and heating the product to redness. Smalt is a preparation of cobalt largely used in the arts as a coloring material, and consists of silicate of potash and cobalt. It is in fact a potash glass colored by silicate of cobalt, and is prepared as follows: Zaffre is melted in pots, with suitable proportions of pure sand and potash and a little saltpetre. The other metals combine together and sink in a metallic mass, which is called speiss. The glass containing the oxide of cobalt is ladled out and poured into water to granulate it, and is then ground to powder. This being introduced into vats of water, the colored glass subsides in deposits, which gradually diminish in their proportions of oxide of cobalt. The first are of the deepest blue, and are called azure; but of this, and of the succeeding fainter shades, there are many varieties, distinguished by peculiar names. When finely powdered, smalt is applied to coloring wall papers, and bluing linen, besides being incorporated with porcelain to impart to it permanent blue shades. The great value of oxide of cobalt, amounting to $7.75 per pound, renders it an important object to fully develop the resources of the country in its ores, as well for export as for domestic use. In 1856 there were imported into Great Britain 428 tons of cobalt ore, and 34 tons of oxide of cobalt.

### NICKEL.

Nickel is a metal of some commercial importance, and is employed chiefly for producing, with copper and zinc, the alloy known as German silver. The proportions of these metals are not constant, but the most common in use are eight parts of copper to three each of nickel and zinc. The larger the proportion of copper, the more easily the plates are rolled; but if more is used than the relative amounts named, the copper soon becomes apparent in use. The new cent contains 12 parts of nickel to 88 of copper, and the manufacture of this adds somewhat to the demand. The metal has been mined at Chatham, Conn., and is met with at Mine la Motte, and other localities where cobalt is found. It occurs in greatest abundance at an old mine in Lancaster county, Penn., where it is associated with copper ores. The mine was originally worked for copper, it is said, more than one hundred and thirty years ago, and was reopened for supplying nickel for the U. S. Mint, on the introduction of the new cent in 1857. The sulphuret of nickel, containing, when pure, 64.9 per cent. of nickel, and 35.1 per cent. of sulphur, is in very large quantity, in two veins of great size, one of which has been traced over 600 feet, and the other over 900 feet in length. In 1859 it was producing at the rate of two hundred tons of nickel ore and ten tons of copper ore per month. A pyritous variety of nickel ore, called siegenite, is found at Mine la Motte, Missouri, and in Carroll county, Maryland. In Gaston and Lincoln counties, North Carolina, similar ore was found by Prof. Wurtz, as noticed in the remarks on cobalt, above. It has also been found recently in iron mines in Connecticut, and in combination with other metals in the west. It has recently come largely into demand for plating purposes, and a new discovery has been made by which it is rendered as malleable as silver. (See chapter on ELECTRO-PLATING.)

### CHROME OR CHROMIUM.

The ore of this metal, known as chromic iron or chromate of iron, has been mined for many years in the United States, both for exportation and domestic use. It is the source whence the chrome colors are obtained that are largely used in the arts, especially in dyeing and calico printing. The name of the metal, from a Greek word meaning color, was given in consequence of the fine colors of its compounds. It usually consists of the sesquioxide of chromium in proportion varying from 36 to 60 per cent., protoxide of iron from 20 to 37 per cent., alumina sometimes exceeding 20 per cent., and more or less silica, and sometimes magnesia. Its value consists only in the first-named ingredient. The localities of the ore are in the serpentine rocks of different parts of the United States, as in the Bare Hills, near Baltimore, and near the Maryland state line on the southern edge of Chester and Lancaster counties, Pennsylvania. In small quantities the ore is met with at Hoboken, Staten Island, and other places near New York city. It is found in several towns in Vermont, but the largest veins of it are in Jay, in the northern part of the state. The composition of this ore was found by Mr. T. S. Hunt to be 49.9 of green oxide or sesquioxide of chromium, 48.96 of protoxide of iron, and 4.14 per cent. of alumina, silica, and magnesia. Though the quantity of the ore in this region is reported to be large, the principal supplies of the country have been obtained in Maryland, and from the mines just over the state line in Pennsylvania. The ore, as recently as 1854, was found in loose fragments among the disintegrated materials of the serpentine upon the tracts called the barrens, and was gathered up from the valleys and ravines, and dug out in sinking shallow pits and trenches over the surface. The ore thus obtained was called "sand chrome," and for a time it had been worth $45 per ton, and thousands of tons had been collected and shipped, principally to Baltimore. At the period named these superficial deposits were mostly exhausted, and the value of the ore was only about $25 per ton. This, however, was sufficient to sustain regular mining operations, which were then carried on upon the veins found in the serpentine, a little west of the east branch of the Octorara Creek. Wood's chrome mine, near the Horseshoe Ford, was at that time about 150 feet deep, and the workings had been extended northeast and southwest about 300 feet, upon an irregular vein of chrome ore, which lay at an inclination of about 45° with the horizon toward the northwest. The ore, in places, formed bunches, which attained a width of twenty feet, and then thinned away to nothing. Four men obtained from the mine seven or eight tons of excellent ore a day, the best of which was directly placed in barrels for the foreign market, and the poorer was dressed and washed for the Baltimore and other home markets. The state line mine, in the same vicinity, worked to about the same depth, had produced several thousand tons. The supplies of this ore are always of uncertain continuance. The metal chromium is rarely obtained pure, and is worth about $58 per pound—about three times the value of silver.

Useful Applications. — Chromate of iron is used chiefly in the production of chromate of potash, and from this the other useful chromatic salts are obtained. The object in view in the chemical treatment of the ore is to convert the sesquioxide of chromium into the peroxide or chromic acid, and cause this to combine with potash. This may be effected by various methods, as by exposing a mixture of the pulverized ore and of saltpetre (nitrate of potash) to a strong heat for some hours. The chrome is peroxidized at the expense of the oxygen of the nitric acid of the saltpetre, and the chromic acid combines with the potash; or if the ore is mixed with carbonate of potash and calcined, the peroxidation of the chrome is effected by admission of air into the furnace, and the same product is obtained as in the employment of saltpetre. The introduction of lime hastens the operation. Other mixtures also are used for the same purpose. When the calcined matter, having been drawn out from the furnace, is lixiviated with water, the chromate of potash is dissolved and washed out, and is afterward recovered in the form of yellow crystals on evaporating the water. From chromate of potash the other salts are readily produced. Chrome yellow, used as a paint, is prepared by mixing chromate of potash with a soluble salt of lead, and collecting the yellow precipitate of chromate of lead which falls. A bright red precipitate is obtained by thus employing a salt of mercury, and a deep red with salts of silver. Chrome green is produced by mixing Prussian blue with chrome yellow. Some new and very interesting compounds of the sesquioxide of chromium with different bases were obtained some years since by Prof. A. K. Eaton, of New York, and in consequence of their decided colors and the extraordinary permanency of these against powerful reagents applied to remove them, the salts were employed for printing bank notes. Though they proved to be all that was required as to the colors themselves, the steel plates were so rapidly cut by the excessively sharp and hard powders, however finely they were ground, that it was found necessary to abandon their use. The new salts were chromites —that of iron having a dark purple color; of manganese, a lighter shade of the same; of copper, a rich bluish black; of zinc, a golden brown; of alumina, a green, somewhat paler than that of the sesquioxide.

### MANGANESE.

Though this is a metal of no value of itself one of its ores, called pyrolusite, is a mineral of some commercial importance, chiefly on account of the large proportion of oxygen it contains, part of which it can be easily made to give up when simply heated in an iron retort. The composition of pyrolusite, or black oxide of manganese, is 63.4 per cent. of manganese, and 36.6 per cent. of oxygen. It is a hard, steel-gray ore, resembling some of the magnetic iron ores, and is often found accompanying iron ores, especially the hematites. In the United States it is met with in various localities along the range of the hematites, from Canada to Alabama, and has been mined to considerable extent at Chittenden and Bennington, Vermont; West Stockbridge and Sheffield, Mass.; on the Delaware river, and near Kutztown, Berks Co., Penn.; and abounds in different parts of the gold region in North Carolina and South Carolina, and in most of the gold and silver mines of the western states and territories. Usually the ore is found in loose pieces among the clays which fill the irregular cavities between the limestone strata; its quantity is, of course, very uncertain, and its mines are far from being of a permanent character. Oxide of iron is commonly mixed with the manganese ore, reducing its richness, and at the same time seriously injuring it for some of the purposes to which it is applied. As obtained from the mines, the assorted ore is packed in barrels and sent to the chemical establishments, where it is employed principally in the manufacture of chloride of lime or bleaching powder. For this purpose the pulverized black oxide of manganese is introduced into hydrochloric acid, and this being heated a double decomposition takes place, a portion of its chlorine is expelled, and the hydrogen that was combined with it unites with a part of the oxygen of the pyrolusite. The chlorine, which it was the object of the process to obtain, is then brought in contact with hydrate of lime, and uniting with the calcium base forms the bleaching powder. A similar result is obtained by mixing the oxide of manganese with chloride of sodium (common salt), and adding sulphuric acid. By these operations a weight of oxygen equal to about one-third that of the pure ore may be obtained, and this may be applied to any of the purposes for which oxygen not absolutely pure is required. Black oxide of manganese is also used to decolorize glass stained green by the presence of the protoxide of iron. Its own amethystine tint is supposed to neutralize the optical effect of the greenish hue of the iron. Pure pyrolusite, free from iron, might be shipped with profit to Liverpool, where it is worth $35 to $40 per ton, but inferior ore would involve bills of cost. The chemically prepared permanganate of potassa has come into extensive use as an antiseptic, of late years. Manganese is also used in the manufacture of some of the compounds of steel.

### TIN.

The very useful metal, tin, is not produced in any considerable quantities in this country, and though it has been found in moderate quantity in Maine, California, and some of the other western states, it is hardly probable that it will be extensively mined here. Tin is imported chiefly from the mines of Cornwall, England, and from Banca, and other islands of the Malay archipelago. The United States is one of the largest consumers of tin, sheet tin having been applied, through the ingenuity of the workers of this article in Connecticut, to the manufacture of a variety of useful utensils. What is called sheet tin is really sheet iron coated with a very thin layer of tin. The sheets are prepared in England by dipping the brightened iron sheets into a bath of melted tin. The process has been applied to coating articles made of iron, which are thus protected from rusting; and zinc is also used for similar purposes. Such are stirrups, bridle-bits, etc. Cast-iron pots and saucepans are tinned on the inside by melted tin being poured in and made to flow over the surface, which has been made chemically clean to receive the metal. The surface is then rubbed with cloth or tow. Tin is imported in blocks or ingots, and the metal is applied to the preparation of various alloys, as bronze or bell-metal, composed of copper and tin in variable proportions, commonly of 78 parts of copper, and 22 of tin; gun-metal, copper 90, and tin 10; pewter, of various proportions of tin and lead, or when designed for pewter plates, of tin 100, antimony 8, bismuth 2, and copper 2; and soft solder, consisting of tin and lead, usually of two parts of the former to one of the latter. Bismuth is sometimes added to increase the fusibility of the alloy.

## CHAPTER IX.

### COAL.

To the early settlers of the American colonies the beds of mineral coal they met with were of no interest. In the abundance of the forests around them, and with no manufacturing operations that involved large consumption of fuel, they attached no value to the black stony coal, the real importance of which was not in fact appreciated even in Europe until after the invention of the steam engine. The earliest use of mineral coal was probably of the anthracite of the Lehigh region, though it may be that the James river bituminous coal mines, twelve miles above Richmond, were worked at an earlier period than the Pennsylvania anthracites. The region containing the latter belonged to the tribes of the Six Nations, until their title was extinguished and the proprietary government obtained possession, in 1749, of a territory of 3,750 square miles, including the southern and middle of the three anthracite coal-fields. In 1768 possession was acquired of the northern coal-field, and at the same time of the great bituminous region west of the Alleghany mountains. The existence of coal in the anthracite region could not have escaped the notice of the whites who had explored the country, for its great beds were exposed in many of the natural sections of the river banks and precipitous hills, and down the mountain streams pieces of coal, washed out from the beds, were abundantly scattered. The oldest maps now known dating as far back as 1770, and compiled from still older ones, designate in this region localities of "coal;" but these were probably not regarded as giving any additional value to the territory. The first recorded notice of its use was in the northern basin by some blacksmiths in 1770, only two years after the whites came in possession; and in 1775 a boat load of it was sent down from Wilkesbarre to the Continental armory at Carlisle. This was two years after the laying out of the borough of Wilkesbarre by the Susquehanna Land Company, of Connecticut. From this time the coal continued to be used for mechanical operations by smiths, distillers, etc.; and according to numerous certificates from these, published in 1815, in a pamphlet by Mr. Zachariah Cist, of Wilkesbarre, they had found it very much better for their purposes, and more economical to use than Virginia bituminous coal, though at the enormous price of ninety cents a bushel. Gunsmiths found it very convenient for their small fires, and one of them, dating his certificate Dec. 9, 1814, stated that he had used it for twenty years, consuming about a peck a day to a fire, which was sufficient for manufacturing eight musket-barrels, each barrel thus requiring a quart of coal. Oliver Evans, the inventor of the steam engine, certifies in the same pamphlet to his having used it for raising steam, for which it possessed properties superior to those of any other fuel. Judge Fell, of Wilkesbarre, applied it to warming houses in 1808, and contrived suitable grates for this use of it; but the cheapness of wood and the greater convenience of a fuel which every one understood how to use, long prevented its general adoption. In the first volume of the "Memoirs of the Historical Society of Pennsylvania," T. C. James, M.D., gives "a brief account of the discovery of anthracite coal on the Lehigh," in which he describes a visit he made to the Mauch Chunk mountain in 1804, where he saw the immense body of anthracite, into which several small pits had been sunk, and which was afterward worked, as it is still, as an open quarry. He states that he commenced to burn the coal that year, and had continued to use it to the time of making this communication, in 1826. The discovery of this famous mass of coal was made in 1791, and in 1793 the "Lehigh Coal Mine Company" was formed to work it. But as there were no facilities for transporting the coal down the valley of the Lehigh, nothing was done until 1814, when, at great labor and expense, twenty tons were got down the river and were delivered in Philadelphia. Two years before this a few wagon loads had been received there from the Schuylkill mines; but the regular trade can hardly be said to have commenced until 1820, when the receipts in Philadelphia amounted to 365 tons. Such was the commencement of the great anthracite trade of Pennsylvania, which in the course of sixty years has been steadily increasing, till it had reached the amount of 37,315,858 tons for the year 1880, of which, however, 9,382,086 was "culm," or waste, and sustained numerous branches of metallurgical and mechanical industry, the dependence of which upon this fuel and source of power was not dreamed of when its mines were first opened.

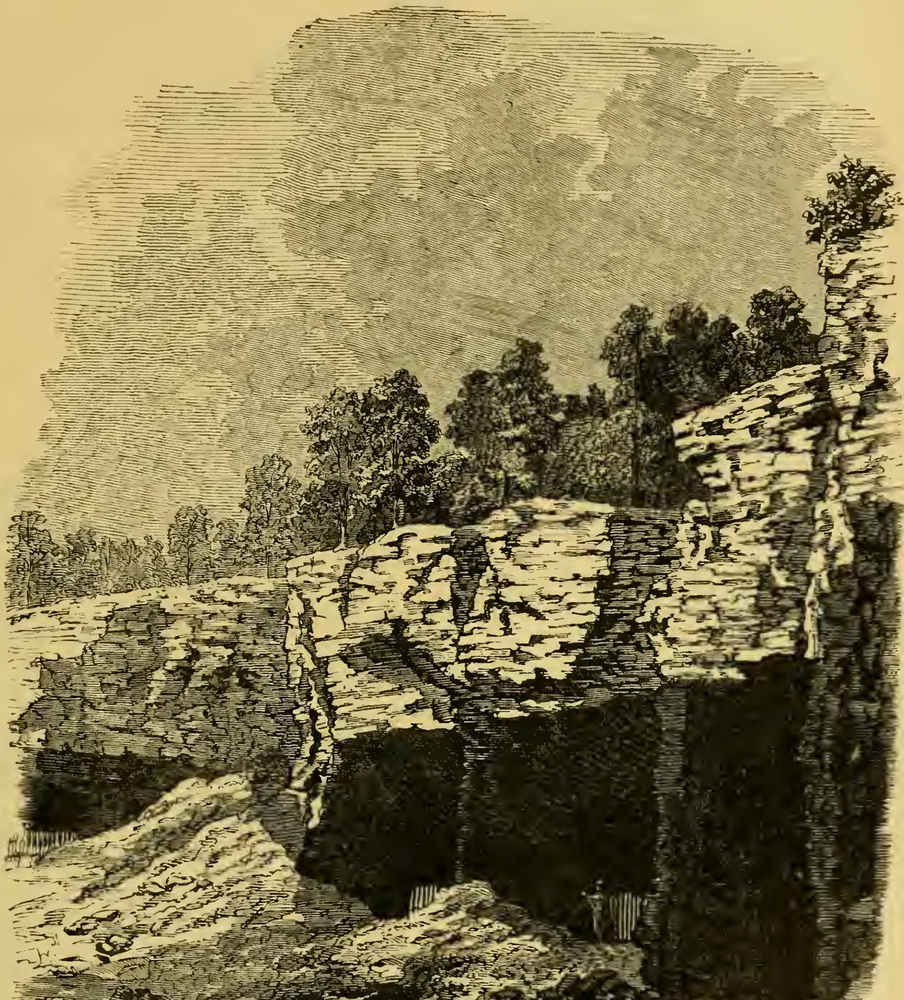
The existence of bituminous coal west of the Alleghanies was probably known as early as was that of anthracite in the eastern part of Pennsylvania; and on the western rivers it could not fail to have been noticed by the early missionaries, voyageurs, and hunters. In the old maps of 1770 and 1777 the occurrence of coal is noted at several points on the Ohio. A track of coal land was taken up in 1785 near the present town of Clearfield, on the head-waters of the west branch of the Susquehanna, by Mr. S. Boyd, and in 1804 he sent an ark load of the coal down the Susquehanna to Columbia, Lancaster county, which, he states, caused much surprise to the inhabitants, that "an article with which they were wholly unacquainted should be thus brought to their own doors." This was the commencement of a trade which has since been prosecuted to some extent by running rafts of timber loaded with coal, and sometimes with pig iron also, from the head-waters to the lower portion of the Susquehanna. The bituminous coal mines on the James river, twelve miles above Richmond, in Virginia, were also worked during the last century, but at how early a period we are ignorant. In an account of them in the first volume of the "American Journal of Science," published in 1818, they are spoken of as already having been worked thirty years.

### VARIETIES OF COAL.

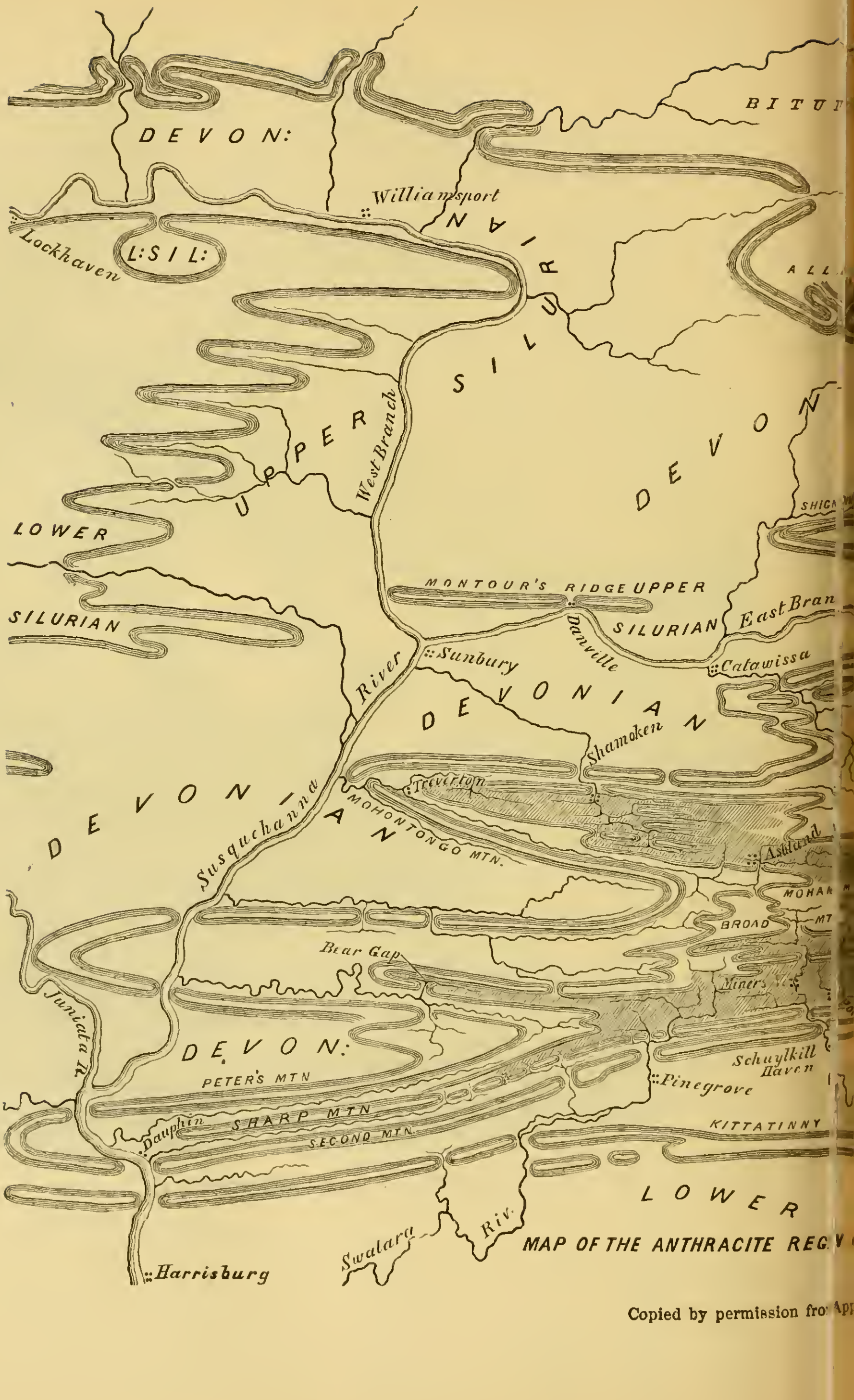
The mineral coals are found of various sorts, which are distinguished by peculiarities of appearance, composition, and properties. Derived from vegetable matters, they exhibit in their varieties the successive changes which these have undergone from the condition of peaty beds or deposits of ligneous materials—first into the variety known as brown coal or lignite, in which the bituminous property appears, while the fiber and structure of the original woody masses is fully retained; next into beds of bituminous coal comprised between strata of shales, fire-clay, and sandstones; and thence through several gradations of diminishing proportions of bitumen to the hard stony anthracite, the composition of which is nearly pure carbon; and last of all in this series of steps attending the conversion of wood into rock, the vegetable carbon is locked up in the mineral graphite or plumbago. These steps are clearly traceable in nature, and in all of them the strata which include the carbonaceous beds have undergone corresponding changes. The clayey substratum that supports the peat appears under the beds of mineral coal in the stony material called fire-clay (used when ground to make fire-brick); the muddy sediments such as are found over some of the great modern peat deposits, appear in the form of black shales or slates, which, when pulverized, return to their muddy consistency; the beds of sand, such as are met with in some of the peat districts of Europe interstratified with different peat beds, are seen in the coal measures in beds of sandstones; and the limestones which also occur in the same group of strata, represent ancient beds of calcareous marls. The slow progression of these changes is indicated by the different ages of the geological formations in which the several varieties occur. Beds of peat are of comparatively recent formation, though some of them are still so old that they are found at different depths, one below another, separated by layers of sand, clay, and earth. Brown coal, or lignite, is commonly included among the strata of the tertiary period; the bituminous coals are in the secondary formations; and the anthracites, though contained in the same geological group with the great bituminous coal formations, are in localities where the strata have all been subjected to the action of powerful agents which have more or less metamorphosed them and expelled the volatile bitumen from the coal. The graphite or plumbago is in still older groups, or in those which have been still more metamorphosed by heat.

Each of these processes is attended with loss of some of the original constituents of the vegetable tissue or wood which goes through the successive stages of distillation, terminating in graphite, better known as plumbago or black lead. Chemists have formulated these changes as follows:

| Vegetable tissues. | Constituents. | Loss. | Peat. |
|---|---|---|---|
| Carbon, ........ | 49.1 | 21.50 | 27.6 |
| Hydrogen, ...... | 6.3 | 3.50 | 2.8 |
| Oxygen, ........ | 44.6 | 29.10 | 15.5 |
| Wood. | Constituents. | Loss. | Lignite. |
| Carbon, ........ | 49.1 | 18.65 | 30.45 |
| Hydrogen, ...... | 6.3 | 3.25 | 3.05 |
| Oxygen, ........ | 44.6 | 24.40 | 20.30 |



BALTIMORE COMPANY'S MINE, WILKESBARRE, PA.




MAP OF THE ANTHRACITE REG

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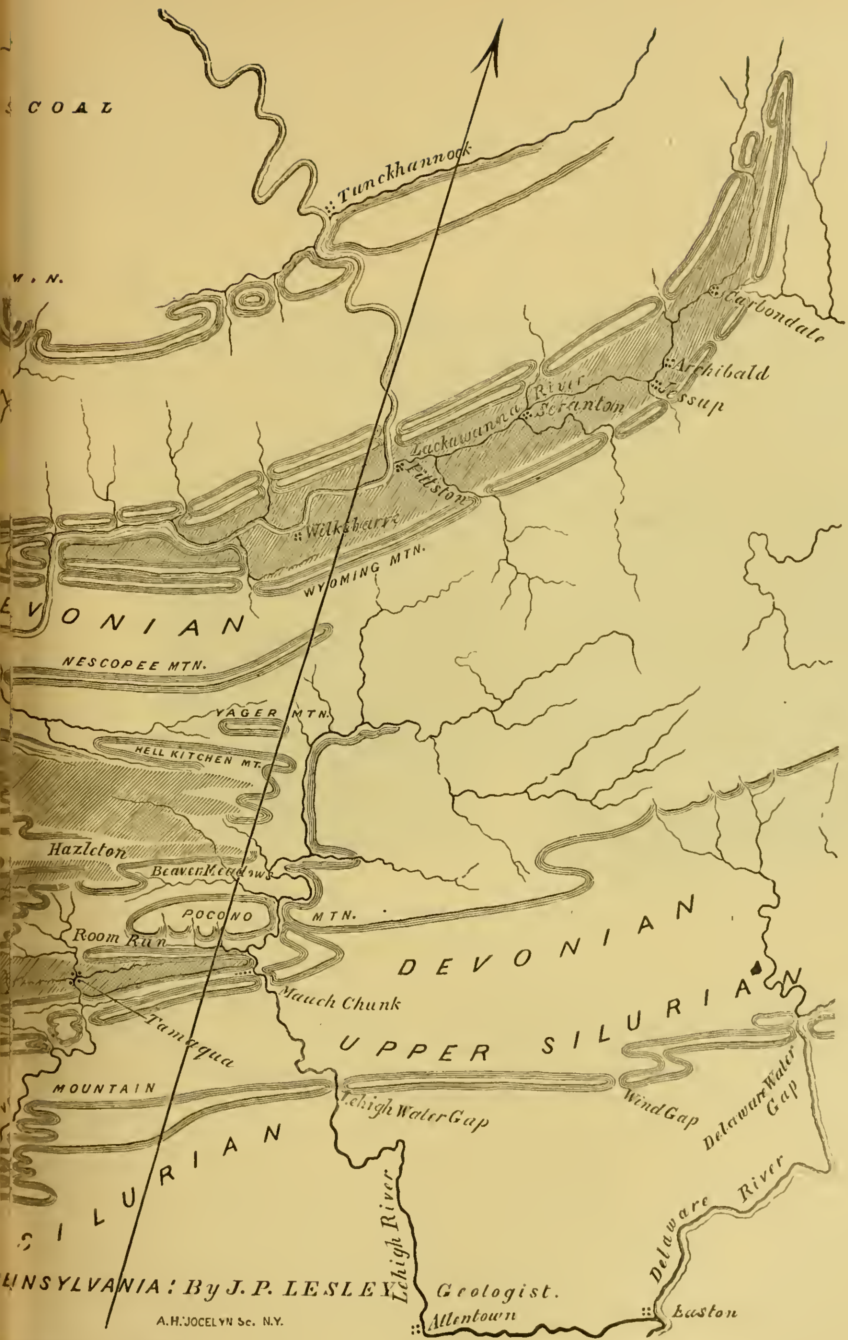
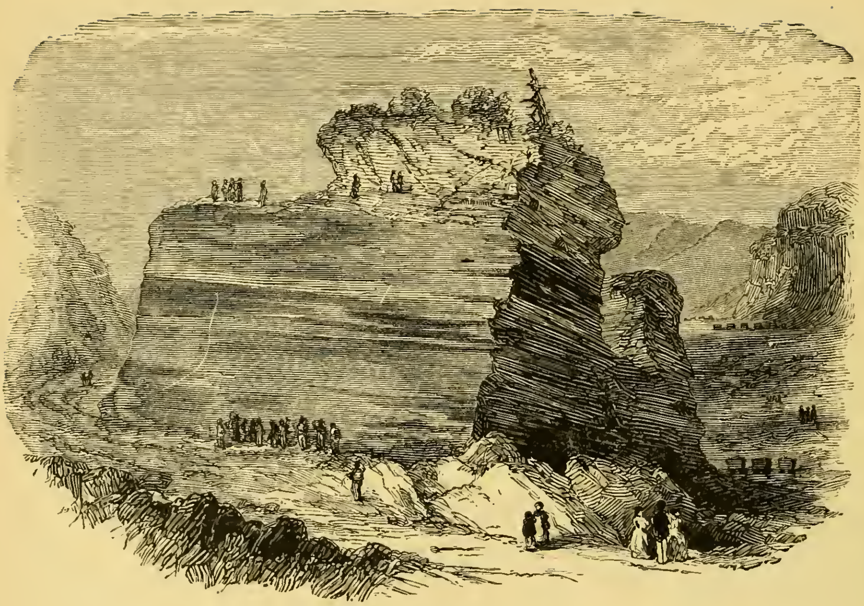



American Cyclopedia.



THE GREAT OPEN QUARRY OF THE LEHIGH.

In working this great quarry of anthracite at the Summit mine, above Mauch Chunk, blocks of coal were occasionally left standing for a time, one of which, surmounted by the soil of the original surface and the relics of the vegetation, is represented in the above cut. In this block are discerned the lines of stratification of the coal; and an idea of its extraordinary thickness and extent is conveyed by the appearance of the cliffs upon the further side of the excavated area. Upon the floor of the quarry are seen the mining wagons used for conveying away upon temporary tracks the coal and rubbish of the excavations.

Under a heavy pressure, caused usually by ages of successive deposits, or perhaps by upheaval of mountain chains, the distilling process goes on, and the lignite or peat is transformed into bituminous coal. The varying pressure produces an almost infinite variety of bituminous coals, and other substances are often combined with the carbon, hydrogen, and oxygen.

| Lignite. | Constituents. | Loss. | Bituminous coal. |
|---|---|---|---|
| Carbon, ........ | 30.45 | 12.35 | 18.10 |
| Hydrogen, ...... | 3.05 | 1.85 | 1.20 |
| Oxygen,........ | 20.30 | 18.13 | 2.07 |

The process of distillation goes on, aided, perhaps, by volcanic action, and the bituminous coal becomes *anthracite*.

| Bituminous coal. | Constituents. | Loss. | Anthracite. |
|---|---|---|---|
| Carbon, ........ | 18.10 | 3.57 | 14.53 |
| Hydrogen, ...... | 1.20 | 0.93 | 0.27 |
| Oxygen,........ | 2.07 | 1.32 | 0.75 |

And with still higher heat and pressure this becomes *graphite*.

| Anthracite. | Constituents. | Loss. | Graphite. |
|---|---|---|---|
| Carbon, ........ | 14.53 | 1.42 | 13.11 |
| Hydrogen, ...... | 0.27 | 0.14 | 0.13 |
| Oxygen,........ | 0.75 | 0.75 | 0.00 |

These are only average proportions of each class of coals.

All these varieties of fossil fuel are found in the United States. Peat beds of small extent are common in the northern portion of the country, and in some parts of New England are used for fuel, and the muck, or decomposed peat, as a fertilizer to the soil. In the great swamps of southern Virginia, the Carolinas, and Georgia, vegetable deposits of similar nature are found upon a scale more commensurate with the extent of the ancient coal-beds. Lignite of excellent quality is found in workable beds at the west, as in some parts of Germany and England, and in scattered deposits of small extent among the tertiary clays, near the coast of New Jersey, Delaware, and Maryland. The distribution of the true coal formations will be pointed out after designating more particularly the characters of the different coals. All of these consist of the elements carbon, hydrogen, oxygen, and often nitrogen; the carbon being in part free, and in part combined with the other elements to form the volatile compounds that exist to some extent in all coals. Earthy matters which form the ash of coals are always intermixed in some proportion with the combustible ingredients, and water, also, is present. When coals are analyzed for the purpose of indicating their heating quality by their composition, it is enough to determine the proportions of fixed carbon, of volatile matter, and of ash which they contain. How the combined carbon, hydrogen, oxygen, and the little nitrogen in their composition, may be distributed in the forms of carburetted hydrogen, ammonia, the bituminous oils, etc., cannot be ascertained by analysis, as the means employed to separate most of these compounds cause their elements to form other combinations among themselves; the determination of the ultimate proportions of all the elements would serve no practical purpose. So, if it be required to prove the fitness of any coal for affording illuminating gas, or the coal oils, it must be submitted to experiments having such objects only in view; and even their capacity for generating heat is better determined by comparative experiments in evaporating water, than by any other mode. The bituminous coals are characterized by their large proportion of volatile matter, which, when they are heated, is expelled in various inflammable compounds, that take fire and burn, accompanied by a dense, black smoke, and a peculiar odor known as bituminous. If the operation is conducted without access of air, as in a closed platinum crucible, the fixed carbon remains behind in the form of coke; and by removing the cover to admit air, this may next be consumed, and the residuum of ash be obtained. By several weighings the proportions are indicated. Coals containing 18 per cent. or more of volatile matter are classed among the bituminous varieties; but as the proportion of this may amount to 70 per cent. or more, there is necessarily a considerable difference in the characters of these coals, though their most marked peculiarities are not always owing to the different amounts of volatile matter they contain. Thus, some sorts, called the "fat bituminous," and "caking coals," that melt and run together in burning, and are especially suitable for making coke, contain about the same proportion of volatile matter with the "dry coals," as some of the cannel and other varieties which burn without melting, and do not make good coke. Other varieties are especially distinguished for their large proportion of volatile ingredients; such are the best cannels, and those light coals which have sometimes been mistaken for asphaltum, as the Albert coal of the province of New Brunswick. These varieties are eminently qualified for producing gas or the coal oils; but have little fixed carbon, and consequently can produce little coke. Coals that contain from 11 to 18 per cent. volatile matter, are known as semi-bituminous, and partake both of the qualities of the true bituminous coals, in igniting and burning freely, and of the anthracite in the condensed and long-continued heat they produce. The Maryland coals, and the Lykens valley coal of Pennsylvania, are of this character. The true anthracites contain from 2 to 6 per cent. of gaseous matters, which by heat are evolved in carburetted hydrogen and water, even when the coal has been first freed from the water mechanically held. Their greatest proportion of solid carbon is about 95 per cent. There remains a class which has been designated as semi-anthracite, containing from 6 to 11 per cent. of combustible volatile matter. These coals burn with a yellowish flame, until the gas derived from the combination of its elements is consumed.

The earthy ingredients in coals, forming their ash, are derived from the original wood and from foreign substances introduced among the collections of ligneous matters that make up the coal-beds. The ash is unimportant, excepting as the material which produces it takes the place of so much combustible matter. In some coals, especially those of the Schuylkill region, it is red, from the presence of oxide of iron, and in others it is gray, as in the Lehigh coals. This distinction is used to designate some of the varieties of anthracite; but the quality of these coals is more dependent on the quantity of the ash than on its color. From numerous analyses of the Schuylkill red ash coals an average of 7.29 per cent. of ash was obtained, and of the white ash anthracite, 4.62 per cent. Coals producing red ash are more likely to clinker in burning than those containing an equal amount of white ash. In some varieties of coal the proportion of earthy matter is so great that the substance approaches the character of the bituminous shales, and may be called indifferently either shale or coal. Though such materials make but poor fuel, some of them have proved very valuable from the large amount of gas and of oily matters they afford. The most remarkable of this class is that known as the Boghead cannel. This is largely mined near Glasgow, in Scotland, and is imported into New York to be used in the manufacture of coal oil. It is a dull black, stony-looking substance, having but little resemblance to the ordinary kinds of coal. Some of the cannel and gas-producing coals of Kentucky, West Virginia, Ohio, and Illinois closely compare with the Boghead cannel, as do also the Nova Scotia cannels, and they are now largely used for the production of gas.

The writers on coal, such as Professors Walter R. Johnson, Taylor, Daddow, Newberry, and McFarlane, specify many other features affecting the qualities of the coals, and their adaptation to special uses. Some of these are—1, their capacity for raising steam quickly; 2, for raising it abundantly for the quantity used; 3, freedom from dense smoke in their combustion; 4, freedom from tendency to crumble in handling; 5, capacity, by reason of their density, and the shapes assumed by their fragments, of close stowage; and 6, freedom from sulphur. The last is an important consideration, affecting the value of coals proposed for use in the iron manufacture, sulphur, which is often present in coal in the form of sulphuret of iron, having a very injurious effect upon the iron with which it is brought in contact when heated. It is again to be cautiously guarded against in selecting bituminous coals to be employed in steam navigation; for by the heat generated by spontaneous decomposition of the iron pyrites, the easily ignited bituminous coals may be readily set on fire. This phenomenon is of frequent occurrence in the waste heaps about coal mines, and large bodies of coal stored in yards and on board ships have been thus inflamed, involving the most disastrous consequences. In stowage capacity coals differ greatly, and this should be attended to in selecting them for use in long voyages. Tendency to crumble involves waste. Dense smoke in consuming is objectionable in coals required for vessels-of-war in actual service, as it must expose their position when it may be important to conceal it.

The general results of experience in use, as well as of special trials systematically conducted upon a large scale, agree in these particulars — that while the bituminous coals are valuable for the greater variety of uses to which they are applicable, and especially for all purposes requiring flame and a diffusive heat, as under large boilers; and while they are quickly brought into a state of combustion, rendering the heat they produce more readily available; the anthracites afford a more condensed and lasting heat, and are to be preferred in many metallurgical operations, especially where great intensity of temperature is required. And for many purposes, the free-burning, semi-bituminous coals, which combine the useful properties of both varieties, are found most economical in use.

### GEOLOGICAL AND GEOGRAPHICAL DISTRIBUTION.

The United States is supplied with coal from at least ten coal-fields belonging either to the true coal-measures, or carboniferous group, a series of strata sometimes amounting, in aggregate thickness, to 2,000 and even 3,000 feet, and whether found in this country or in Europe, readily recognized by the resemblance in the various members of its formation, its fossil organic remains, its mineral accompaniments, and by its position relative to the other groups of rocks which overlie and underlie it; or to the tertiary period, which includes lignites, bituminous, and some anthracite. The first of these fields or basins is that known as the Appalachian, which, commencing in the northeastern part of Pennsylvania, stretches over nearly all the state west of the main Alleghany ridge, and takes in the eastern portion of Ohio, parts of Maryland, West Virginia, Kentucky, Tennessee, the northwest corner of Georgia, and extends into Alabama as far as Tuscaloosa. Its total area, including a number of neighboring basins, as those of the anthracite region to the east of the Alleghany ridge, which were originally a part of the same great field, is estimated at about 70.000 square miles. A second great basin is that known as the Triassic field, in Virginia and North Carolina, which covers perhaps 5,000 square miles.

Notwithstanding the limited area of the Triassic coal-field in Virginia and North Carolina, it has produced for more than sixty years past large quantities of coal chiefly for the supply of iron manufacturing establishments, and the gas-works along the seaboard to the north. The strata of these coal-measures occupy a deep depression in the granitic rocks of this region, attaining in the center of the basin a thickness of nearly 2,000 feet. They consist in great part of a micaceous sandstone, and the two or three coal-beds are contained in the lower 150 feet. A great bed at the bottom, which in some places exceeds 40 feet in thickness, and in others dwindles away to four or five feet only, appears to have been deposited upon the uneven granitic floor, from which it is separated by only a few inches of slate. Shafts have been sunk near the east border of the coal-field to the depth of nearly 900 feet. The amount of coal obtained in 1880 was only 46,246 tons. A singular phenomenon is observed at one point in this district, where a coal-bed is penetrated and overlaid by a body of trap-rock. The coal near this rock is converted into a mass of coke, resembling that artificially produced, except that it is more compact and of a duller lustre.

A third great field includes the larger part of Illinois, most of Indiana, and a portion of Kentucky. Its area is estimated at 50,000 square miles. The coal is bituminous and largely charged with oil. A fourth coal-field is the anthracite district in Pennsylvania, comprising part of eight counties of that state—the principal, though not the only source of supply of anthracite in the United States. A fifth is the small tract in Rhode Island, which is the only region yielding a graphite anthracite in the United States. A sixth coal-field occupies the central portion of the southern peninsula of Michigan, its area being about 13,350 square miles. Several beds of bituminous coal are worked in this district, and produced in 1880, 100,000 tons.

The seventh coal-field is that known as the Missouri, which extends from Iowa, where it covers a large area through Missouri, eastern Nebraska and Kansas, Arkansas, the eastern portion of the Indian Territory, and eastern Texas. This coal-field is reckoned as covering 47,138 square miles. The coal is bituminous, from the middle coal-measures of the carboniferous system, and is in many places of excellent quality, belonging to the class of coking coals, which are valuable for heating and smelting purposes. The eighth field begins in British America, near the Saskatchewan river, and passes southward through western Dakota, southeastern Montana, eastern Wyoming, western Nebraska and Kansas, through Colorado, east of the Rocky Mountains, northeastern New Mexico, and central and western Texas. It covers about 40,000 square miles, is a lignite of the cretaceous period, a very fair heating coal, yielding some gas, but not coking. At some points it assumes the characteristics of a cannel coal. It cannot be considered of the first quality. The ninth coal-field is a very remarkable one. Beginning like the preceding in British America, it passes through western Montana and Idaho, through western Wyoming and Utah, western Colorado and New Mexico, and perhaps eastern Nevada, through Arizona and northwestern Texas, into Mexico. This is a lignite, but of the tertiary period, being found at the north only in the miocene, but in Texas principally in the eocene strata. In western Colorado, in Utah, and in New Mexico, near Santa Fé, volcanic action has changed it into an anthracite coal, that in New Mexico and Colorado being of a quality nearly equal to that of the Pennsylvania mines. At other places, as in parts of Utah, it has been changed by a less intense volcanic action into a semi-bituminous coal, some beds of which coke and give evidence of being a good smelting coal. The extent of this coal-field cannot be less than 50,000 square miles. The tenth is in reality two coal fields which interlock; the one, lignites of the tertiary, which pass through eastern Washington and Oregon, and in California appear on both sides of the Coast Range; the other, coming from Alaska, through British Columbia, and sending out a branch to Queen Charlotte Islands, through Vancouver Island, and the Straits of San Juan de Fuca, along the coasts of Puget Sound, and of Washington and Oregon, growing constantly poorer and more charged with sulphur till, in California, it interlaces with the tertiary lignite. Its composition seems to vary. It seems to be a cretaceous lignite, as the interlocking coal-field is a tertiary, but in Alaska, in Queen Charlotte Islands, and on Vancouver Island it has been changed by volcanic action to an anthracite or a semi-anthracite of fine quality; at Bellingham Bay, into a bituminous coal, regarded as the best on the Pacific coast; and in the Monte Diablo mines, in California, into a fine quality of bituminous coal, though with rather too much sulphur. The area of this coal-field is nearly 60,000 square miles. The whole area of these coal-fields is not much less than 850,000 square miles. The product of the mines on these coal-fields in 1880 (and it is constantly and rapidly increasing, especially in the west), was 80,449,662 tons—about five-ninths of the product of the English and Welsh mines the same year.

A large amount of bituminous coal has been brought to Boston and New York, for many years past, from a coal-field belonging to the true coal-measures, in Nova Scotia and Cape Breton. The same formation extends into New Brunswick and ranges along the western part of Newfoundland, and has been estimated as comprising in all an area of 9,000 square miles. The productive portions, however, are limited to a few localities upon the coast of Nova Scotia and Cape Breton, and at these, beds of great thickness have been opened, and worked to the depth of from 200 to 450 feet. At the Pictou mines, opposite the southern point of Prince Edward's Island, one bed is twenty-nine feet thick. Another bed, at the Albion mines, eight and a half miles from Pictou, affords twenty-four feet of good coal, and twelve more of inferior quality; and in Sydney, Cape Breton, are beds of eleven feet, nine feet, and six feet, besides at least eleven others of less thickness. At the South Joggins cliffs, in Nova Scotia, the total thickness of all the strata of the coal-measures was found by Mr. Logan to amount to 14,571 feet, very much exceeding the thickness of the formation as observed in other places on the American continent.

The strata which make up the coal formation, the principal varieties of which have already been named, are regularly laid one upon another in no particular order, and amount in aggregate thickness to several thousand feet, rarely exceeding in the United States 3,000 feet. Their thickness is ascertained by sections measured at different localities, some giving one part of the column, and others other portions. In western Pennsylvania, at Pittsburg, the hills opposite the city afford a section of three hundred or four hundred feet, and the marked stratum is here the great coal-bed, which up the Alleghany river toward the north rises to higher and higher levels in the hills, and toward the south, up the Monongahela, sinks to lower levels, till it passes beneath the bed of the stream. By extending these observations over the coal-field, it is found that the whole series of strata maintain their general arrangement, and the principal members of the group, such as an important coal-bed, a peculiar bed of limestone, etc., may be identified over areas of thousands of square miles. It is thus the sections have been prepared at many localities to complete the series, as presented on the opposite page, of the bituminous coal-measures of the extreme western part of Pennsylvania. The coal beds introduced are those which are persistent over the greatest areas. Others occasionally appear in different parts of the column, and various other local differences may be detected, owing to the irregularities in the stratification; thus sandstones and slates often thin out, and even gradually pass from one into the other. By their thinning out beds of coal separated by them in one locality may come together in another, and form one large bed; and again, large coal-beds may be split by hardly perceptible divisional seams of slate or shale, which may gradually increase till they become thick strata, separating what was one coal-bed into two or more. The limestones, though generally thin, maintain their peculiar characters much better than the great beds of sandstone or shale, and are consequently the best guides for designating in the columns the position of the strata which accompany them, above and below. The fire-clay is almost universally the underlying stratum of the coal-beds. In the sections it is not distinguished from the shale-beds. The total thickness of all the measures is from 2,000 to 2,500 feet. In the west, the cañons of the large rivers afford an infallible guide to the location of coal-beds in particular strata. Prof. Powell states that in the cañons of the Colorado and its constituent streams, strata aggregating a thickness of 25,000 feet are laid bare in their order of position, and it is easy thus to trace coal-beds, which might otherwise have escaped discovery.

Such is the general system of the coal-bearing formation west of the Alleghanies. Every farm and every hill in the coal-field is likely to contain one or more beds of coal, of limestone, of good sandstone for building purposes, of fire-clay, and some iron ore; and below the surface, the series is continued down to the group of conglomerates and sandstones, which come up around the margins of the coal-fields and define their limits. At Pittsburg this group (it is found by boring, as well as by the measurements of the strata in the hills toward the north) is about 600 feet below the level of the river. The coal-measures in this portion of the country are the highest rock formation; but in the western territories beyond the Mississippi they pass under later geological groups, as the cretaceous and the tertiary. All the coals are bituminous, and the strata in which they are found are little moved from the horizontal position in which they were originally deposited. They have been uplifted with the continent itself, and have not been subjected to any local disturbances, such as in other regions have disarranged and metamorphosed the strata.

East of the Alleghanies, in the narrow, elongated coal-fields of the anthracite region, a marked difference is perceived in the position assumed by the strata, and also in the character of the individual beds. They evidently belong to the same geological series as the bituminous coal-measures, and the same succession of conglomerates, sandstones, and red shales, is recognized below them; but the strata have been tilted at various angles from their original horizontal position, and the formation is broken up and distributed in a number of basins, or canal-shaped troughs, separated from each other by the lower rocks, which, rising to the surface, form long narrow ridges outside of and around each coal-field. Those on each side being composed of the same rocks, similarly arranged, and all having been subjected to similar denuding action, a striking resemblance is observed, even on the map, in their outlines; and in the ridges themselves this is so remarkable that their shapes alone correctly suggest at once to those familiar with the geology of the country, the rocks of which they are composed. Upon the accompanying map, these basins are represented by the shaded portions, and the long, narrow ridges which surround the basins, and meet in a sharp curve at their ends, are indicated by the groups of four parallel lines. Within the marginal hills the strata of the coal-measures, and of the underlying formations, while retaining their arrangement in parallel sheets, are raised upon their edges and thrown into undulating lines and sharp flexures; and the extrac-

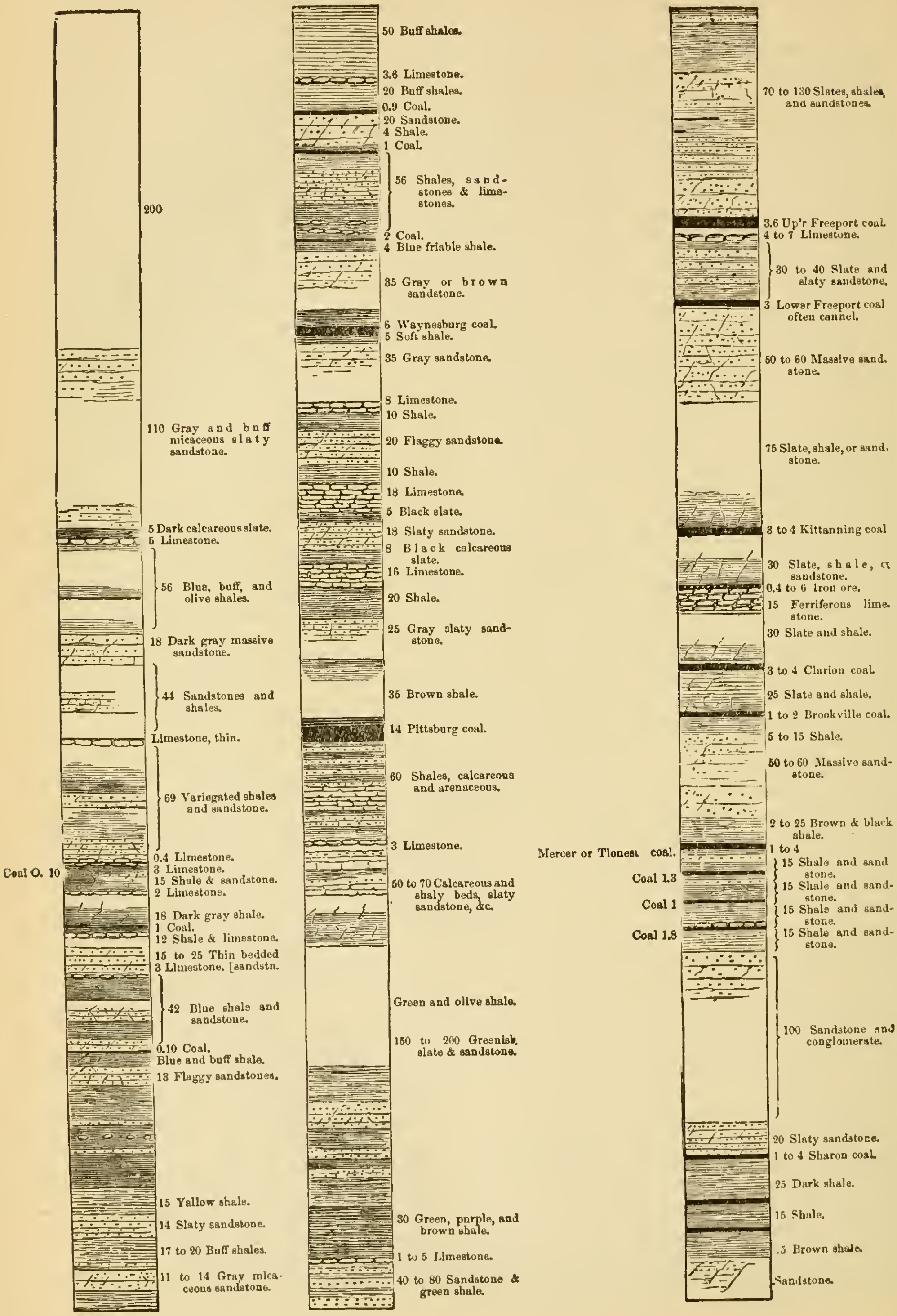
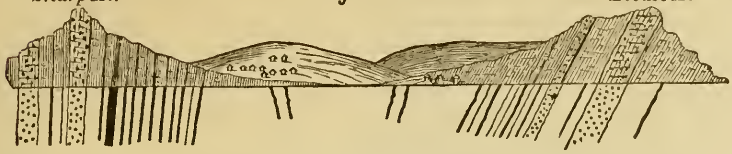

200
110 Gray and buff micaceous slaty sandstone.
5 Dark calcareous slate.
5 Limestone.
56 Blue, buff, and olive shales.
18 Dark gray massive sandstone.
44 Sandstones and shales.
Limestone, thin.
69 Variegated shales and sandstone.
0.4 Limestone.
Coal O. 10
3 Limestone.
15 Shale & sandstone.
2 Limestone.
18 Dark gray shale.
1 Coal.
12 Shale & limestone.
15 to 25 Thin bedded
3 Limestone. [sandstn.
42 Blue shale and sandstone.
0.10 Coal.
Blue and buff shale.
13 Flaggy sandstones.
15 Yellow shale.
14 Slaty sandstone.
17 to 20 Buff shales.
11 to 14 Gray micaceous sandstone.
50 Buff shales.
3.6 Limestone.
20 Buff shales.
0.9 Coal.
20 Sandstone.
4 Shale.
1 Coal.
56 Shales, sandstones & limestones.
2 Coal.
4 Blue friable shale.
35 Gray or brown sandstone.
6 Waynesburg coal.
5 Soft shale.
35 Gray sandstone.
8 Limestone.
10 Shale.
20 Flaggy sandstone.
10 Shale.
18 Limestone.
5 Black slate.
18 Slaty sandstone.
8 Black calcareous slate.
16 Limestone.
20 Shale.
25 Gray slaty sandstone.
35 Brown shale.
14 Pittsburg coal.
60 Shales, calcareous and arenaceous.
3 Limestone.
50 to 70 Calcareous and shaly beds, slaty sandstone, &c.
Green and olive shale.
150 to 200 Greenish slate & sandstone.
30 Green, purple, and brown shale.
1 to 5 Limestone.
40 to 80 Sandstone & green shale.
70 to 130 Slates, shales, and sandstones.
3.6 Up'r Freeport coal.
4 to 7 Limestone.
30 to 40 Slate and slaty sandstone.
3 Lower Freeport coal often cannel.
50 to 60 Massive sandstone.
75 Slate, shale, or sandstone.
3 to 4 Kittanning coal
30 Slate, shale, or sandstone.
0.4 to 6 Iron ore.
15 Ferriferous limestone.
30 Slate and shale.
3 to 4 Clarion coal.
25 Slate and shale.
1 to 2 Brookville coal.
5 to 15 Shale.
50 to 60 Massive sandstone.
2 to 25 Brown & black shale.
Mercer or Tionesta coal.
1 to 4
15 Shale and sandstone.
Coal 1.3
15 Shale and sandstone.
Coal 1
15 Shale and sandstone.
Coal 1.8
15 Shale and sandstone.
100 Sandstone and conglomerate.
20 Slaty sandstone.
1 to 4 Sharon coal.
25 Dark shale.
15 Shale.
.5 Brown shale.
Sandstone.

Fig. 1



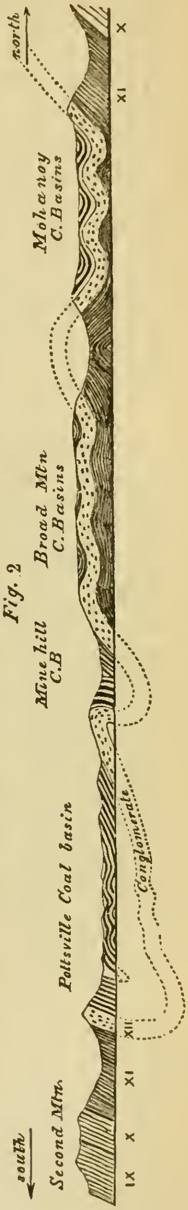




Fig. 2

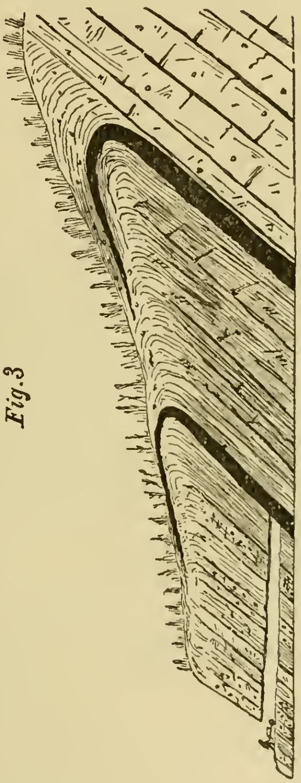


Fig. 3

tion of the coal, instead of being conducted by levels driven into the side of the hills, is effected by means of inclined shafts following down the course of the beds from the surface, or by vertical slopes sunk so as to cut them at considerable depths. The arrangement of the strata in its general features is represented in the accompanying wood cuts. Fig. 1 is a section from Sharp Mountain, on the south side of the Mauch Chunk summit mine, across this great body of coal, and the higher coal-beds of the formation repeatedly brought to the surface by their changes of dip, to Locust Mountain, which bounds the basin on the north. Fig. 2 is a section across the same basin at Tamaqua, six miles west from Mauch Chunk mine. In this section it is seen how the coal-measures are separated into basins by the lower rocks coming up to the surface and forming anticlinal axes. Fig. 3 represents the position of single beds, as they occur among the slates and sandstones, and the manner in which they are sometimes reached by means of a tunnel driven in from the base of the hill. The curved portion of the coal at the top is formed by the coal-beds at their outcrop becoming disintegrated, and their fragments and decomposed smut being spread down the slope of the hill. The Roman numerals, "IX," "X," "XI," "XII," in fig. 2, designate the lower formations of rock, known respectively as the red sandstones (corresponding to the "Old Red Sandstone"); a series of gray sandstones; one of red shales; and lastly, the conglomerate. The dotted lines above and below the section mark the continuity of the conglomerate beneath the base of the section and its original course above the present surface before this portion had been removed by diluvial action. The other formations obviously accompany the conglomerate with similar flexures.

The same cause, that threw the strata into their inclined and contorted positions, no doubt changed the character of the coal by dispelling its volatile portions, converting it in fact into coke, while the pressure of the superincumbent beds of rock prevented the swelling up of the material, as occurs in the ordinary process of producing coke from bituminous coal, and caused it to assume the dense and compact structure of anthracite. As the anthracite basins are traced westward, it is observed that the coals in those districts which have been less disturbed, retain somewhat of the bituminous character; and if the continuity were uninterrupted between the anthracite and the bituminous coal-fields, there is no doubt that a gradual passage would be observed from the one kind of coal to the other, and that this would be accompanied by an amount of disturbance in the strata corresponding to the degree in which the coal is deficient in bitumen.

## AMOUNT OF AVAILABLE COAL.

In estimating the quantities of workable coal in any district, several points are to be taken into consideration besides the amount of surface covered by the coal-measures and the aggregate thickness of all the beds they contain. Out of the total number of coal-beds, there are more or less of them that must be excluded from the estimate, on account of their being too thin to work. The great depth at which the lower beds in the central parts of the Appalachian coal-field lie must probably prevent their ever being worked; but for this no allowance is ever made in the estimates of quantities of coal.

The most careful and complete computations of this nature which have been made are those of Professor H. D. Rogers, and of Mr. Bannan in the Coal Statistical Register for 1871. From these sources we obtain the following estimates:

EXTENT OF COAL-FIELD IN THE SEVERAL STATES POSSESSING THE COAL FORMATION.

| | Sq. miles. |
|---|---|
| Massachusetts and Rhode Island | 100 |
| Pennsylvania | 12,656 |
| Ohio | 7,100 |
| Maryland | 550 |
| Virginia | 15,900 |
| Kentucky | 13,700 |
| Tennessee | 3,700 |
| Alabama | 6,130 |
| Georgia | 170 |
| Indiana | 6,700 |
| Illinois | 40,000 |
| Michigan | 13,350 |
| Iowa | 24,000 |
| Missouri | 21,329 |
| Nebraska | 84,000 |
| Kansas | 80,000 |
| Arkansas | 12,597 |
| Indian Territory | 40,000 |
| Texas | 30,000 |
| New Mexico | 20,000 |
| Wyoming | 20,000 |
| Colorado | 20,000 |
| Montana | 74,000 |
| Remainder of the West | 100,000 |
| Total | 650,862 |

In the anthracite basins of Pennsylvania the number of workable beds varies from 2 or 3 to 25, according to the depth of the basin; the average number is supposed to be 10 or 12. The maximum thickness of coal is in the Pottsville basin, and amounts to 207 feet. Rejecting the thin seams, the average thickness in the south anthracite field is reckoned at 100 feet; in the middle or north field at about 60 feet; and the general average of the whole, 70 feet.

The maximum thickness of the 15 or 16 coal-beds of the central part of the Appalachian coal-field is about 40 feet, but the average of the whole basin is considered to be 25 feet.

The basin extending over Illinois and into Indiana and Kentucky, contains in the last-named state 16 or 17 workable beds, with a maximum thickness of about 50 feet. The average over the whole area is supposed to be 20 or 25 feet.

The following estimates of the British coal-fields are introduced for comparison. Extending these computations to Belgium and France also, the result of calculations of available coal supply, in 1870, are as follows:

RELATIVE AMOUNT OF COAL IN THE SEVERAL GREAT COAL-FIELDS OF EUROPE AND AMERICA.

| | Tons. | Ratio. |
|---|---|---|
| Belgium (assuming an average thickness of about 60 feet of coal) contains about | 36,000,000,000 | 1 |
| France (with same thickness) contains about | 59,000,000,000 | 1 64 |
| The British Islands (averaging 35 feet thickness) contain nearly | 190,000,000,000 | 5.28 |
| Pennsylvania (averaging 25 feet thickness) contains | 316,400,000,000 | 8.8 |
| The great Appalachian coal-field (including Pennsylvania, averaging 25 feet) | 1,387,500,000,000 | 38.5 |
| Coal-field of Indiana, Illinois, and western Kentucky (average thickness 25 ft) | 1,277,500,000,000 | 35.5 |
| The Rocky Mountain basin (averaging 30 feet) | 3,739,000,000,000 | 10.29 |
| All the productive coal-fields of North America (with an assumed thickness of 20 feet of coal, and a produc ing area of 200,000 sq. miles) | 6,720,400,000,000 | 186 |
| All the coal-fields of Europe | | 8.75 |

The following table, though probably not absolutely accurate, gives as near an approximation as is attainable of the coal production of the United States, from the begin-

MOUNT PISGAH PLANE, MAUCH CHUNK, PA.

COLLIERY SLOPE AND BREAKER AT TUSCARORA, PA.

ning in 1819 to 1881. It is from official sources:—

ANTHRACITE COAL IN TONS OF 2,240 POUNDS.
Calendar Years, 1819–1881.

| | Tons. |
|---|---|
| From all the regions in Penn., .... | 509,287,439 |
| Anthracite elsewhere, ............ | 180,000 |
| Bituminous, semi-bituminous, and semi-anthracite in Penn., ........ | 154,068,550 |
| Bituminous elsewhere, ............ | 244,700,000 |
| | 908,235,989 |

Of this great product, that of 1880 was:

| | |
|---|---|
| Anthracite coal including culm, ... | 38,029,081 |
| Bituminous coal east and west, .... | 42,420,581 |
| Production of coal, all kinds, 1880, | 80,449,662 |

So that, at the present rate of production, there would be raised in eleven years an amount equal to that of the last sixty-two years.

TRANSPORTATION OF COAL TO MARKET.

The first anthracite from the Schuylkill mines was brought to Philadelphia in wagons. The navigation of the river and canal was hardly practicable for boats previous to the year 1822; and though from that year anthracite was conveyed to Philadelphia and the trade continued to increase, it was not until 1825 that a large amount of coal could be transported by this route. The effect of these improvements was experienced in the transportation of 6,500 tons in 1825; in 1826 it increased to 16,763. As for successive years the trade steadily and rapidly increased in importance, the capacity of the canal proved at last insufficient for it, and the Reading railroad was laid out for its accommodation, and constructed with a uniform descending grade from the mining region at Pottsville to the Delaware river. It was opened in 1841, and proved a formidable competitor to the Schuylkill canal, but the increasing trade has surpassed the capacity of both these routes. Other lines have been constructed, till now there are more than twenty railroads engaged almost exclusively in the transportation of the anthracite and semi-anthracite coals from the mines.

As seen by the table, the first shipments of anthracite were from the Lehigh region, two years before any were sent from the Schuylkill. The transportation was effected by arks or large boxes built of plank, and run down the rapid and shoal river with no little risk. To return with them was impracticable, nor was this desired, for the arks themselves were constructed of the product of the forests, which in this form was most conveniently got to market. As the coal trade increased in importance, the Lehigh Coal and Navigation Company, to insure greater facility in running the arks, constructed dams across the shoaler places in the river, by which the water was held back, thus increasing the depth above. As the arks coming down the river reached one of these dams, the sluice-gates were opened, and the boats descended to the next dam below. At first two arks were connected together by hinges at the ends; subsequently more were thus joined together, till they reached nearly two hundred feet in length. In 1831 the slack-water navigation of the Lehigh was so far perfected, that it was used by canal boats ascending and descending through regular locks.

Up to the year 1827 the transportation of anthracite to Mauch Chunk, nine miles from the mines, was by wagons. The Mauch Chunk road, completed in May, 1827, was made with a descending grade, averaging about 100 feet to the mile, so that the loaded cars ran down by gravity. Each train carried down with it in cars appropriated to this use the mules for drawing the empty cars back; and it is stated that after the animals once became accustomed to the routine of their duties they could never be made to travel down the road if accidentally left behind. The trade before many years outgrew these increased facilities of transporting the coal, and it was found essential to return the empty cars by some more economical method. On account of the heavy up-grade, locomotives, it was concluded, could not be advantageously employed, and hence a system of inclined planes and gravity roads was devised, by which the cars hoisted by stationary power to the summit of the planes and thence descending the gravity roads might be returned to the mines. In the accompanying sketches a part of this arrangement of roads is exhibited.

The high hill called Mount Pisgah, above the village of Mauch Chunk, is the terminating point at the Lehigh river of the long ridge called Sharp Mountain. The lower road seen in the sketch is called the loaded track. The cars come by this from the mines, and being let down the inclined plane at its terminus, their loads are discharged into the great bins over the edge of the river. They are then hauled a short distance to the foot of the long plane that reaches to the summit of Mount Pisgah, and by the stationary steam engine are drawn up in about six minutes to an elevation 850 feet above that at the foot. The length of this plane is 2,250 feet. From its summit the empty cars run down the inclined road constructed along the south side of the ridge, and at the distance of six miles, having descended about 300 feet, they reach the foot of another inclined plane at Mount Jefferson. This plane is 2,070 feet long, rising 462 feet. The ascent is accomplished in three minutes, and from the top another gravity road extends about a mile, descending 44 feet to the Summit Hill Village. From this point branch roads lead to the different mines in Panther Creek valley, and all meet again in the loaded track road by which the cars return to Mauch Chunk.

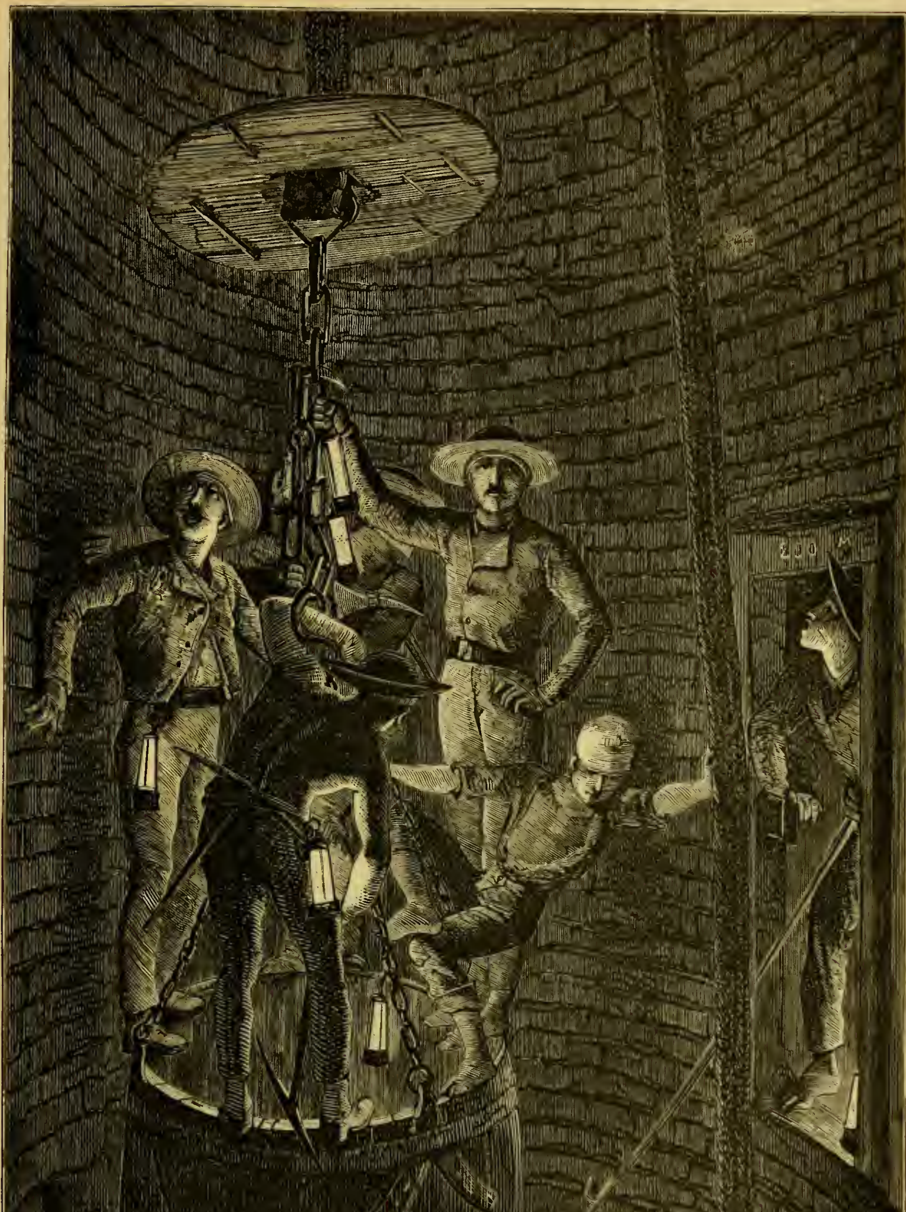
The transportation of coal from Mauch Chunk was conducted by the river and canal exclusively until the partial construction of the Lehigh Valley railroad in 1846. This road was completed in 1855, and its rival, the Lehigh and Susquehanna, a few years later, and the two have proved important outlets for this coal region, and have rendered the canal trade comparatively unprofitable.

A considerable amount of anthracite finds a market on the borders of Chesapeake Bay, being transported from the mines near the Susquehanna river by the Susquehanna tide-water canal, and by the Northern Central railroad. Its consumption is extending in this region by its use in the blast furnaces in the place of charcoal, for smelting iron ores, and the receipts of this fuel in the city of Baltimore are about one-third of those of the semi-bituminous coals of the Cumberland region, which are brought to the city by the Baltimore & Ohio railroad and the canal.

The principal outlet of the Northern coal field had been, from 1829 to 1850, by the Delaware and Hudson canal. Beginning with 440,000 tons in 1847, the amount of coal transported to the Hudson river had reached 565,460 tons in 1855; 1,206,314 tons in 1869, and in 1880 about 1,800,000 tons. The Canal Company own or lease several railroad lines, and connect with three or four trunk roads. Their coal freight over these is at least four times that of the canal itself. The various railroads and canals which have been constructed with especial reference to the transportation of anthracite, are very numerous, and their aggregate cost exceeds $550,000,000.

### COAL MINING.

Coal-beds are discovered and worked by different methods, varying according to the circumstances under which they occur. In regions where they lie among the piles of strata horizontally arranged, and passing with the other members of the group upon a level or nearly so through the hills, their exact position is often detected by their exposure in the precipitous walls of rock along the rivers; or it is indicated by peculiar indentations, known as "benches." around their line of outcrop, caused by their crumbling and wearing away more rapidly than the harder strata above and below them; and again by the recurrence of springs of water and wet places at the foot of the benches, which point to an impervious stratum within the hill that prevents the water percolating any further down; and lastly, in the little gorges worn by the "runs," the beds are often uncovered, and loose pieces of coal washed down lead to their original source above. However discovered, the method of working them is simple. A convenient place is selected upon the side of a hill, and an excavation called a drift, usually about four feet wide, is made into the coal-bed. The height of the drift is governed by the thickness of the coal-bed and the nature of the overlying slate. Miners sometimes work in drifts only 2½ feet high. Coal-beds three or four feet thick are very common, and are

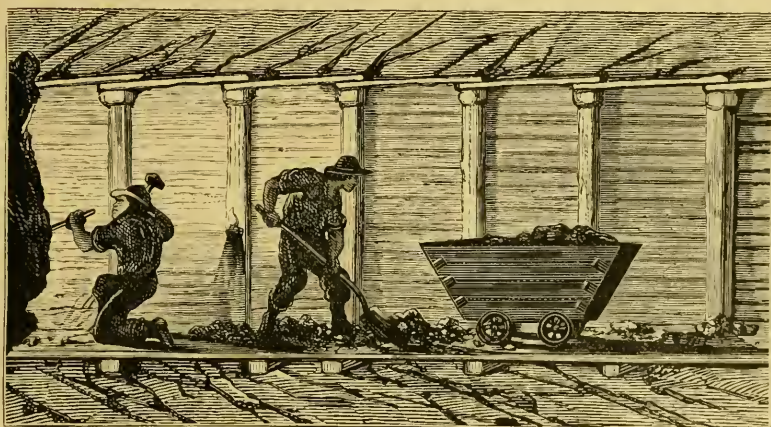


FIRE-DAMP EXPLOSIONS, RARE IN ANTHRACITE, BUT FREQUENT IN BITUMINOUS MINES.

INUNDATION TROUBLESOME, ESPECIALLY IN ENGLISH MINES.

BREAKING OF PROPS AND CAVING IN.

UNDERMINING COAL.—See page 141.



BREAKING OFF AND LOADING COAL.

DRAWING OUT COAL WHERE THERE IS NOT SUFFICIENT DEPTH OF VEIN TO ADMIT MULE TEAMS.

worked without the necessity of removing the overhanging slate, unless it is too unsound to serve as a roof. Beds of ten feet thickness or more require much additional care over those of smaller size, both in removing the coal and supporting the roof; and in many cases it is found expedient to leave a portion of the bed, either at the top or bottom, untouched, especially if the upper layers contain, as they often do, sound sheets of slate. At the entrance of the mines, and in general in all places where the cover is not sound, the materials overhead are prevented from falling by timbers across the top of the drifts, rudely framed into posts set up against the walls on each side; and where the strata are very loose, slabs are driven in over the cross timbers and behind the posts. In such ground the coal cannot be excavated over large areas without leaving frequent pillars of coal and introducing great numbers of posts or props. But previous to abandoning the mine the pillars may be removed, commencing with those furthest in, and all the strata above are thus allowed to settle gradually down. When drifts or gangways have been extended into the coal-beds far enough to be under good cover, branches are commenced at right angles, and a system of chambers is laid out for excavation, leaving sufficient blocks or pillars of coal to provide for the support of the overlying strata. Thus the work is carried on, ventilation being secured by connections made within the hill with gangways passing out in different directions, and sometimes also by shafts sunk from the surface above, or, when these means are not practicable, by ventilating fans worked by hand, and thus forcing air through long wooden boxes which lead into the interior of the mine. Drainage is often a serious trouble, and unless the strata slope toward the outlet of the mine, it can be effected only by a channel cut to the required depth for the water to flow out, or else by the use of pumping machinery. When the strata lie nearly upon a horizontal plane, it is very common for a slight descent to be found from the exterior of a hill toward its centre, as if the beds of rock had been compressed and settled by their greater weight in the middle of the hill. In such positions the coal is extracted with much expense for drainage, and it is therefore an important consideration in judging of the value of coal-beds to ascertain whether or no the water will flow freely out from the excavations. West Virginia and the bituminous coal-measures on the west side of the Appalachian range generally, the coal-beds are usually far up the sides of the ravines or cañons, and shutes can be built so as to slide the coal directly from the mine into the cars of the railroad without its being handled at all. It does not pay to work bituminous coal mines below water level.

It is rare that bituminous coal is obtained by open quarrying. Where the beds lie near the surface, so that they might be uncovered, the coal is almost invariably in a rotten condition and worthless. Consequently one of the first points to be assured of in judging of the value of a coal-bed is that it has sufficient rock cover. After this may be considered the quality of the coal, its freedom from sulphur, etc., the soundness of its roof, and the facilities offered for drainage and ventilation. The quality of a coal-bed undergoes little or no change after it is once reached under good cover beyond atmospheric influences; and hence no encouragement can be given to continue to work a poor bed in hopes of its improving.

Coal is excavated chiefly by light, slender picks. With one of these a miner makes a shallow, horizontal cut as far as he can reach under the wall of coal before him, stretching himself out upon the floor to do this work, and then he proceeds to make a vertical cut extending from each end of that along the floor up to the roof. By another horizontal cut along the roof, a cubical block of coal is thus entirely separated from the bed, except on the back side which cannot be reached. The separation is completed by wedges driven into the upper crevice, or sometimes by small charges of powder. By this means blocks of coal are thrown down amounting to 70 or 80 tons in weight, and with the least possible loss by the reduction of portions of it to dust and fine coal.

The cost of mining and delivering coal at the mouth of the mines, varies with the size and character of the beds. Under the most favorable conditions the horizontal beds of bituminous coal, as those in the hills opposite Pittsburg, have been worked and the coal delivered outside for 1½ cents a bushel, or 45 cents a ton; but in general the total expenses are nearly double this rate. In estimating the capacity of production of coal-beds it is usual to allow a ton of coal to every cubic yard, and a bed of coal a yard thick should consequently contain a ton to every square yard, or 4840 tons to the acre: but the actual product that can be depended on, after the loss by fine coal, by pillars left standing, etc., may not safely be reckoned at more than 3000 tons, or for every foot thickness of the bed 1000 tons.

In the anthracite region, and in other coal districts where the beds are of large size and lie at various degrees of inclination with the horizon, the methods of mining differ more or less from those described. The anthracite beds frequently extend in parallel layers longitudinally through the long ridges, dipping, it may be, nearly with the outer slope, and descending to great depths below the surface. In such positions they are conveniently reached at the ends of the ridges and in the gaps across these, by a level driven on the course of the bed, and rising just enough for the water to drain freely. A level or gangway of this sort is the great road of the mine, by which all the coal is to be brought out in case other similar gangways are not driven into the same bed at points further up or down its slope. Unless the dip is very gentle, one at the lowest point should be sufficient. At different points along its extension passageways are cut in the coal, directed at right angles up the slope of the bed, and as soon as one of them can be brought through to the surface, a ventilating current of air is established, which may afterward be diverted through all the workings. The passageways together with other levels above divide the coal-bed into great blocks, and also serve as shutes by which the coal excavated above is sent down to the main gangway. At the bottom of each shute a bin is constructed for arresting the coal and discharging it, as required, into the wagons which are run in beneath on the tracks laid for this purpose. Coal-beds in this position are also worked from the gangway by broad excavations carried up the "breast" or face of the bed, sufficient pillars of coal from 12 to 25 feet long being left in either case to support the roof. These pillars usually occupy the most room just above the gangways, and on passing up between them, the chambers are made to widen out till they attain a breadth of about 40 feet, and thus the breast is extended up to the next level. Props are introduced wherever required to support the roof, and the rubbish, slates, etc., are stacked up for the same purpose, as well as to get them out of the way.

It often occurs that coal beds within the ridges can be reached only by a tunnel driven in from the side of the mountain across their line of bearing. Tunnels of this kind are sometimes extended till they cut two or more parallel coal-beds. Each one may then be worked by gangways leaving the tunnel at right angles and following the coal-beds, and the tunnel continues to be the main outlet of them all.

When it is desirable to obtain the coal from the portion of the bed below the level of the gangway, preparations must first be made for raising the water, which may be done for a time by bucket and windlass, and as the slope is carried down and the flow of water increases, then by mining pumps worked by horse or steam power. The slope may commence from the exterior surface or from the lower gangway of a mine already in operation, and is made large enough to admit wagons, which ascend and descend upon two tracks extending down its floor. At the depth of 200 or 300 feet a gangway is driven at right angles with the slope in each direction on the course of the bed, and from this the workings are carried up the breast as already described. Other gangways are started at lower levels of 100 feet or more each, dividing the mine into so many stories or floors. The coal above each gangway is sent down to its level and is received into wagons. By these it is conveyed to the slope, and here running upon a turn-table, each wagon is set upon the track in the slope and is immediately taken by the steam engine to the surface, another car at the same time coming down on the other track. Reservoirs are constructed upon the different levels to arrest the water, that it may not all have to be raised up from the bottom, and the pumps are constructed so as to lift the water from the lower into the higher reservoirs and thence to the surface. Many mines of this character are opened from the surface, one of which is represented in the cut of the "Colliery Slope and Breaker, at Tuscarora, Pennsylvania." An empty wagon is seen in this cut descending the track from the engine house down into the mouth of the pit, and through the end of the building passes the pump rod which by means of a vibrating "bob" is turned down the pit and works by the side of the track. The men pass down into the mines of this character, sometimes by the wagons, and sometimes by ladders or steps arranged for the purpose between the two tracks. Though the opening, as represented, appears insignificant for an important mine, such a slope may extend several hundred feet in depth, and many gangways may branch off from it to the right and left, extending several miles under ground in nearly straight lines along the course of the bed. These, however, to secure ventilation, must have other slopes coming out to the surface, and at these may be other arrangements for discharging the coal and water. In extensive mines the gangways are made wide and capacious for the continual passing back and forth of the wagons drawn by mules. These animals once lowered into the mine are kept constantly under ground, where they are provided with convenient stables excavated from the coal and rock. The men continue at work from eight to ten hours, and in well-ventilated mines the employment is neither very laborious, hazardous, nor disagreeable. The pursuit has, however, little attraction for Americans, and is mostly monopolized by Welsh, English, Irish, and German miners.

In the anthracite region there have been some remarkable instances of open quarries of coal. That of the Summit mine of the Lehigh is unsurpassed in the history of coal mining, for the enormous body of coal exposed to view. The great coal-bed, which appears to have been formed by a number of beds coming together through the thinning out of the slates that separated them, arches over the ridge, forming the uppermost layers of rock, and dipping down the sides at a steeper angle than their inclination. It thus passes beneath the higher strata. On the summit a thin soil, formed chiefly of the decomposed coal itself, covered the beds and supported a growth of forest trees. For several feet down the coal was loose and broken before the solid anthracite was reached. As the excavations were commenced and carried on from this point, it appeared as if the whole mountain was coal. Shafts were sunk into it and penetrated repeated layers of anthracite, separated by thin seams of slate, to the depth, in some places, of more than 55 feet. The work of stripping off and removing the covering of yellow and greenish sandstones and refuse coal was carried on, till the quarry had extended over about 50 acres, and on the north side the overlying sandstone, which had been steadily increasing in thickness, presented a wall of 30 to 40 feet in height. Over this area rail tracks were laid for removing the waste northward to the slope of the hill toward the Panther Creek valley; and when the piles thus formed had grown into large hills, the rubbish was deposited in the spaces left after the coal had been removed. During the progress of this work the scenes presented were of the most picturesque and novel character. The area laid bare was irregularly excavated into steps, upon which temporary rail tracks were laid in every direction. Upon these the wagons were kept busily running, some carrying off the coal, some loaded with slates and waste, and others returning empty for their loads. Here and there stood huge isolated masses of anthracite, with their covering of sandstone, soil, and the relics of the original forest growth, reaching to the height of 50 or 60 feet, monuments of the vast amount of excavation that had been carried on, and presenting in their naked, vertical walls, fine representations of the extraordinary thickness of the bed and of the alternating layers of slate and coal of which it was composed. In the accompanying cut of the great open quarry of the Lehigh is represented one of these blocks. Gradually these masses disappeared as the miners continued their operations; but in the boundary walls of the quarry there are still to be seen black cliffs of solid coal more than 50 feet high, and overtopped by a wall of yellow sandstone of nearly equal additional height. Under these walls operations have been carried on by the regular system of underground mining. From ten acres of the quarry it has been estimated that 850,000 tons of coal have been sent away, the value of which in the ground at the usual rate of 30 cents per ton, would be \$255,000, or \$25,500 per acre. Estimating the average working thickness of the coal in this part of the coal-field, from the Little Schuylkill to Nesquehoning, at 40 feet, which according to the report of the state geologist is not exaggerated, every available acre contains not less than 65,000 tons. The expense of extracting and preparing the coal from the great bed for market, is stated by the same authority to be 37½ cents per ton for mining and delivering ready for breaking and cleaning. For this operation 12½ cents; and for raising it to the summit and running it to Mauch Chunk 25 cents.

Another locality where coal has been

worked by open quarrying is at the mines of the Baltimore Company, near Wilkesbarre. Here, too, an immense bed of coal was found so close to the surface that it was easily uncovered over a considerable area. As the overlying slates and sandstone increased in thickness, it was found at last more economical to follow the coal under cover; and it was then worked after the manner of mining the bituminous coal-beds west of the Alleghany Mountains. Horizontal drifts twenty-five feet high, which was the thickness of the bed, were carried in from the abrupt wall, several of them near together, and separated by great pillars of coal left to support the roof. The gangways were so broad and spacious that a locomotive and train of cars might have been run into the mine. Within they were crossed by a succession of other levels, and through the wide spaces thus left open the light of day penetrated far into the interior of the hill, gradually disappearing among the forest of black pillars by which it was obstructed and absorbed. This mine has, we believe, now been abandoned in consequence of the accumulation of water.

In the anthracite region, several coal-beds of workable dimensions are often found in close proximity, so that when dipping at a high angle they are penetrated in succession by a tunnel driven across their line of bearing. Larger quantities of coal are thus concentrated in the same area than are ever met with in the bituminous coal-field. In the northern coal-fields, between Scranton and Carbondale, tracts have brought $800 or more per acre, and single tracts of 650 to 700 acres are reported upon by competent mining engineers as containing five workable beds, estimated to yield as follows—each one over nearly the whole area: one bed, working seven feet, 11,200 tons per acre; a second, working eight feet, 12,800 tons per acre; a third, six feet, 9,600 tons per acre; a fourth the same; and a fifth, three feet, 4,800 tons—altogether equalling a production of 48,000 tons per acre, from which 20 per cent. should be deducted for mine waste, pillars, etc.

The anthracite as usually brought out from the mine is mostly in large lumps of inconvenient size to handle. In this shape it was originally sent to market, and when sold to consumers a man was sent with the coal to break it up in small pieces with a hammer. At present every mine is supplied with an apparatus called a coal-breaker, which is run by steam power, and which crushes the large pieces of coal into fragments. It consists of two rollers of cast-iron, one solid, with its surface armed with powerful teeth, and the other of open basket-work structure. These revolve near together, and the coal, fed from a hopper above, is broken between them, and the pieces discharged below into another hopper are delivered into the upper end of a revolving cylindrical screen, made of stout iron wire, and set on a gentle incline. The meshes of this screen are of four or more degrees of coarseness. At the upper end the finer particles only drop through; passing this portion of the screen, the coarser meshes which succeed let through the stove coal sizes, next the "egg coal," and next the "broken coal," while the coarsest pieces of all, called "lump coal," are discharged through the lower end of the screen. Under the screen are bins or shutes, separated by partitions, so as to keep each size by itself. Their floor slopes down to the railway track, and each bin at its lower end is provided with a trap-door, through which the coal is delivered as required into the wagons. The general plan of this arrangement is seen in the preceding wood-cut of the Colliery Slope and Breaker at Tuscarora. The coal wagons are here run from the mine up into the top of the engine house, and thence through the building to the breaker at the upper end of the slope over the shutes. As the coal falls from the screen into these, boys are employed, one in each bin, to pick out and throw away the pieces of slate and stone that may be mixed with the coal. This they soon learn to do very thoroughly and with great activity; and upon the faithfulness with which their work is done depends in no small measure the reputation of the coal.

The processes of mining bituminous coals in the great coal-fields of Ohio, Michigan, Indiana, Illinois, Iowa, Missouri, Kansas, Arkansas, and the states and territories farther west, differ materially according to the location of the coal-veins and the region in which they occur. On the prairies in Indiana, Illinois, Iowa, and Kansas, and to some extent in Michigan and Missouri, they are pits or shafts sunk sometimes through several successive strata of coal, from which levels or adits are run, sustained by the intervening strata of slate or limestone. In more mountainous regions, as in southern Colorado, New Mexico, Washington Territory, California, etc., the coal strata are often found in strata inclining upward, and so are very easily mined and drained.

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## CHAPTER X.

### ILLUMINATING GAS.

The supply of artificial light in abundance, and at little cost, is one of the most important benefits which science and mechanics can confer. It contributes not merely to physical comfort and luxurious living, but supplies the means to multitudes of obtaining instruction during those hours after the cessation of their daily labors, which are not required for sleep, and which among the poor have in a great measure been spent in darkness, on account of the expense of artificial light. A few years ago, it was not unusual, in the less cultivated portions of the country, to see a farmer's family at night gathered around a blazing fire, and some among them seeking by its fitful light to extract the news from a public journal, or perhaps conning their school tasks, and making some attempts at writing or ciphering; and when the hour to retire had come, the younger members disappeared in the dark, and the more honored were favored with a home-made tallow candle, just sufficient for this use, and endurable only to those who were unaccustomed to a more cleanly and efficient method of illumination. With the advance of cultivation and learning, the demand for better light has increased more rapidly than it has been met. The seas were almost exhausted of whales for furnishing supplies of oil. The pork of the west was largely converted by new chemical processes into lard oil and the hard stearine for candles; and numerous preparations of spirits of turpentine, under the name of camphene and burning fluid, were devised and largely introduced with ingenious lamps contrived to secure the excellent light they furnished with the least possible risk of the awful explosions, to which these fluids were liable when their vapor comes in contact with fire. The bituminous coals were made to give up their volatile portions—by one process to afford an illuminating gas, and by another to produce burning oils; and the earth itself was bored by deep wells to exhaust the newly-found supplies of oil gathered beneath the surface at unknown periods by natural processes of distillation. The resinous products of the pine tree were applied to the production of oil and gas for the same purposes; and peat, wood, and other combustible bodies—even water itself—were all resorted to as sources from which the cry for "more light" might be satisfied.

The distillation of carbonaceous and bituminous substances to obtain an illuminating gas is a process, the practical application of which hardly dates back of the present century. The escape of inflammable gases from the earth, in different parts of the world, had been observed, and the phenomenon had been applied to superstitious ceremonials, especially at Bakü, on the shores of the Caspian. The Chinese are said to have applied such natural jets of gas to purposes of both illumination and heating; but the first attempts to light buildings by gas distilled from bituminous coal were made about the year 1798 by Mr. Murdock in the manufactory of Messrs. Boulton & Watt, at Soho, England, and about the same time in France by a Frenchman named Le Bow. The London and Westminster Chartered Gas Light and Coke Company was incorporated in 1810, and Westminster bridge was lighted with gas, Dec. 31, 1813. The process was introduced into this country about the year 1821. Some attempts had been made at an earlier date, as in Baltimore, according to some statements, in 1816, and in New York four years before this. In the New York *News* of August 15, 1859, is an account of the efforts made by Mr. David Melville of that city to establish the use of coal gas in 1812. He lighted his own house with it. and then a factory at Pawtucket. He also succeeded in having it applied to one of the lighthouses on the coast of Rhode Island, and for one year its use was continued with success. But on account of the disturbed state of the times and the prejudices against the use of a new material. the enterprise fell through. In 1822 the manufacture of gas was undertaken in Boston; and the next year the New York Gas Light Company was incorporated with a capital of $1,000,000. The works, however, were not completed and in operation until 1827. Another company, called the Manhattan Gas Light Company, was incorporated in 1830 with a capital of $500,000, which has since been increased to $4,000,000. Such were the beginnings of this branch of manufacture, which has since rapidly extended itself throughout all the cities and many of the towns of the United States, having works in operation requiring a large capital.

Within the last thirty-five years the use of gas has increased with great rapidity throughout the cities and towns of the United States. In 1860, the number of companies manufacturing gas was, according to the statements of the *American Gas Light Journal*, 433, representing a capital of about $59,000,000. In 1870, the number of companies had increased to somewhat more than 800, and the capital represented to over $112,000,000, and in 1880 exceeded $200,000,000. The capital of the gas companies of the state of New York was stated by Mr. Wells in his Report on Local Taxation to have been $20,000,000 in 1870, and in this estimate many of the smaller companies were overlooked. The capital of the gas companies of New York and Brooklyn in 1880 was over $26,000,000. There are certainly seven and probably eight companies whose annual production exceeds 1,000,000,000 cubic feet, and several others are approximating to that amount. The price per thousand feet has varied greatly in different sections, and has fluctuated in all cases with the price of coal and the methods of distillation. In New York City and Brooklyn it has ranged from $2.00 to $4.50. In Philadelphia, where the city manufactures for its citizens, it is now not far from $2.00, but it is alleged that there are great frauds in the management. In Pittsburg it has been as low as $1.50. In the smaller cities it ranges from $3 00 to $6.00 per thousand feet. On the Pacific coast, owing to the high price of gas-producing coals, it has been as high as from $8.00 to $14.00 per thousand feet. As some of the Rocky Mountain coals have proved to be of good quality for the production of gas, the cost will be materially lessened. Notwithstanding the consumption of petroleum oils, there has been an increase in the demand for illuminating gas, and the plans proposed for its production from other hydrocarbons, or by new processes, have generally failed, so that there seems to be a probability of the continued production of gas from coals, though a modification of the water-gas process is moderately successful, and within a few years past some processes of condensing the gas into a liquid, and perhaps a solid, for transportation, have been attempted with a measure of success.

The preparation of illuminating gas from bituminous coal, wood, rosin, and other bodies of organic nature is a chemical process, too complicated to be very fully treated in this place. When such bodies are introduced into a retort and subjected to strong heat, the elements of which they consist, as carbon, hydrogen, oxygen, and nitrogen, resolve themselves into a great variety of compounds, and escape (with the exception of a fixed carbonaceous residue of charcoal or of coke) through the neck of the retort in the form of gas or vapors, some of the latter of which condense on cooling into liquids and solids. These compounds are rendered more complicated by appropriating the elements of air and moisture that may be present in the retort or in the crude material, and also of the foreign substances or impurities contained in the latter. In processes of this kind, the products vary greatly in their character and relative proportions according to the degree of heat employed, and the rapidity with which the operation is conducted. The object in this special distillation is to obtain the largest proportion of the gases richest in carbon, particularly that known as olefiant gas, which consists of 86 parts by weight of carbon and 14 of hydrogen, represented by the formula $C_4 H_4$. This and some other gaseous hydrocarbons of similar composition, or even containing a much larger amount of carbon in the same volume, and hence having a correspondingly greater illuminating capacity, it is found, are produced most freely from carbonaceous substances which contain a large proportion of hydrogen compared with that of oxygen. Many of the common bituminous coals contain about 5.5 per cent. each of hydrogen and oxygen, the rest being carbon. Boghead cannel of Scotland contains 11 per cent. of hydrogen and 6.7 of oxygen; rosin 10 per cent. hydrogen and 10.6 oxygen; wood 5.5 hydrogen and 44.5 oxygen. Of such compounds the cannel yields the richest gas and in largest quantity. Still, as will be more fully explained hereafter, the process may be so conducted as to obtain chiefly liquid instead of gaseous products. With the olefiant gas and the others of similar composition, a number of other gases also appear, some of which seem to be essential for producing the effect required in illuminating gas, though they do not themselves afford light by their combustion. Their part is rather like that of nitrogen in the atmosphere, to moderate the intensity of the more active agent of the mixture. Such are the light carburetted hydrogen, carbonic oxide, and hydrogen, all of which are inflammable, but possess little or no illuminating power. The first named contains in an equal volume only half as much carbon as olefiant gas, its composition being represented by the formula $C_2$ $H_4$, and if its proportion is too great for the purpose it serves as a diluent, the quality of the gas is impaired, and must be corrected by the use of richer material or increased care in the process.

The light produced by the combustion of gas is variable, not only according to the quality of the gas, but also according to the manner in which it is burned. If its elements undergo the chemical changes which constitute combustion simultaneously, the hydrogen combining with the oxygen of the air to form aqueous vapor, and the carbon with oxygen to produce carbonic acid, no yellow flame appears, but instead of this, a pale blue flame like that of hydrogen alone. Such an effect is produced when air is thoroughly intermixed with the gas as it passes through a tube to the jet where it is ignited. But if the conditions of the combustion are such that the hydrogen burns first and appropriates the oxygen in contact with the gas, the particles of carbon are brought to an incandescent state and produce the yellow light before they reach the oxygen with which they combine. The particles may even be arrested while *in transitu* and be deposited upon a cold surface in the form of soot. The greatest heat is produced with the most thorough mode of combustion and the appearance of the pale blue flame; and lamps designed to give great heat are now in general use among chemists, in which gas is burned in this manner. When the air is impelled by a bellows they even produce an intensity of heat sufficient for many crucible operations.

If too much carbon be present a part of it escapes unconsumed and produces a smoky flame, hence the necessity of the diluents or gases deficient in carbon for neutralizing the too large proportion of those gases richest in carbon. The noxious compounds in illuminating gas, and which should be as far as possible extracted from it before it is delivered for consumption, are the sulphurous ingredients formed by the combination of the sulphur of the iron pyrites commonly present in bituminous coals with the carbon, and with the hydrogen and the ammoniacal products. They are the highly offensive sulphurets of carbon, the sulphuretted hydrogen, etc. Carbonic acid, nitrogen, oxygen, carbonate of ammonia and aqueous vapors are to be regarded as foreign substances, though always present to some extent in the gas.

The liquids generated by the distillation mostly condense in two layers on cooling, the upper an aqueous fluid, rendered strongly alkaline by the ammoniacal compounds in solution; and the lower a black tarry mixture commonly known as coal tar, which is composed of more than a dozen different oily hydrocarbons, as benzole, tuluole, etc., and contain in solution the solid oily compounds of carbon and hydrogen, as naphthaline, para-naphthaline, and several others. Many of these are likely to preve of considerable practical importance. Benzole is a highly volatile fluid, a powerful solvent of the resins, india-rubber, gutta percha, greasy matters, etc. A most beautiful light is produced by the flame of benzole mixed with due proportions of common air, and the mixture is effected by passing a current of air through the fluid, the vapor of which it takes up and carries along with it. The difficulty attending this application is the condensation of the benzole and its separation from the air at temperatures below 50°. Above 70° too much vapor is taken up, and the effect is a smoky flame. In Europe much attention has been directed to the separation of the more hidden products of coal tar; and among these the following are enumerated in a statement exemplifying the rapid increase in the value of these products as they are obtained by more extended researches. Benzole worth about 25 cents a pound; nitro-benzole, a substance having the odor and taste of bitter almonds and used as a flavoring, worth, crude, 70 cents, or refined, $1.50 per pound. The ordinary aniline dye for producing the mauve color, $4.50 to $8 per pound, and the pure aniline violet in powder, $240 to $325 per pound, or about its weight in gold. Besides these, the coal-tar products used in chemistry, the arts, and in medicine are stated at more than seventy, and their number and value is constantly increasing.

Gas works established in cities and towns are commonly built in places where the property and buildings around are least likely to be injured by the escape of the products, and rather upon a low than a high level, for the reason that the gas on account of its lightness compared with the atmospheric air ascends more freely than it descends to its points of communication with the external air. The works consist of the apparatus for distilling the coal and receiving the products of the distillation, that for purifying the gas, and that for conveying it to the places where it is consumed, and there measuring the quantity supplied to each customer. The retorts in general use are either of cast-iron or fire-clay. The latter are a late improvement highly recommended, and introduced at the present time into a few of the gas works. Various forms have been tried; the most approved are of ⌓ shape, seven to nine feet long, one or two feet wide, and twelve or fifteen inches high. They are set in the furnace stacks, commonly two on the same horizontal plane, two or more over these, and a fifth at the top. A single furnace fire below is sufficient for heating them, and the capacity of the works is increased by multiplying these fires along the length of the stacks. Sometimes the stacks are made double, so as to take two retorts set end to end, each opening on opposite sides of the stack. In place of two retorts a single long one has been substituted, passing entirely through and having at each end an opening for charging and discharging. In large establishments as many as 600 or more retorts may be set, all of which may be kept employed in the winter season, when the consumption of gas is largest. The outer end of each retort projects a little way in front of the wall of the furnace, and is provided with a movable mouth-piece covering the entire end, which may be readily removed for admitting the charge of coal. Upon the top of this projecting end or neck stands the cast-iron pipe of about four inches in diameter, called the stand-pipe, through which the volatile products pass from the retort. It rises a few feet, then curves over back, and passes down into a long horizontal pipe of large diameter, which is laid upon the outer edge of the brick-work, and extends the whole length of the furnace stacks. This is called the hydraulic main, and into it all the volatile products from the retorts beneath are discharged. It is kept about half filled with water or the liquid tarry matters, and the dip pipes terminate about three inches below this fluid surface. By this arrangement the retorts are kept entirely independent of each other, while their products all meet in one receptacle.

In manufacturing gas it is found necessary to introduce the charge into the retorts already at a full red heat, and bring it as rapidly as possible to the high temperature required for producing the richest gaseous hydrocarbons. A low and slowly-increasing heat causes the ingredients of the charge to form a large proportion of liquid and oily substances, and little gas. It is only while the coal is approaching a vivid red heat that the best gaseous mixtures are obtained; and even these are deteriorated by change in the composition of the olefiant and other rich gases of which they are in part composed, if the mixture is exposed to too high temperature, or remains in contact with red hot surfaces of iron. The duration of the charge used formerly to be from eight to ten hours; but from the observations of the qualities of the gases, evolved at different stages of the process, it has gradually been reduced to four to six hours, varying according to the character of the coal employed. The richest gases are obtained in the first hour, and after this the proportional quantity per hour steadily diminishes at the same time that the quality gradually deteriorates. The temptation, however, to obtain the largest amount of a commodity which is sold only by measure, and to consumers who have no means of assuring themselves of its real quality, no doubt often leads to extending the operation to the separation of gaseous mixtures having very little illuminating power. The manufacturers knowing their materials, and checking their operations by regular photometrical tests, can control the quality of the product as they see fit.

In order that the least loss may be incurred in bringing the charge up to the proper temperature, the retorts are kept at a full red heat; and when ready for a new charge the mouth-piece is partially removed, and the gas that escapes is ignited. When the danger of explosion by sudden admission of air has passed, the lid is removed, and the red hot coke is raked out and quenched with water. The new charge is then introduced by means of a long iron scoop bent up at the sides, which is pushed into the retort, and being turned over, discharges its contents. The mouth-piece is then replaced, and tightly secured with a luting of clay or lime. It is obvious that the more perfectly the coal is freed from moisture, the better must be the gas; and if it were also first somewhat heated, the result would be still more satisfactory. The coals employed at the different gas works of the United States are generally mixtures of the caking coals of the interior, or of those of Richmond, Virginia, and of Nova Scotia, with cannel coal, which for the cities near the coast is imported from Great Britain, and for those in the interior is obtained from the mines of this coal in western Virginia and Kentucky. The larger the proportion of cannel, the better should be the gas, under the same method of manufacture. In the works in New York city, the proportion of cannel is generally from one-third to one-fourth of the whole. Other establishments generally use a less proportion of it. The amount of gas it may produce varies with the kind of cannel from 9.500 cubic feet to the ton to 15,000 cubic feet. The last is the yield of the Boghead cannel. In general, the greater the yield the better also is the quality of the gas, as is indicated by its increased specific gravity, that of the cannel last named being .752, while the gas from other cannels yielding about 10,000 cubic feet may not exceed .500. The best Newcastle coals are not inferior, either in the amount or quality of the gas they afford, to most of the cannels. They produce about 12,000 cubic feet of gas to the ton, and of specific gravity sometimes exceeding .550 or even .600. Of late years much of the gas manufactured in our Atlantic cities is produced from cannels from Nova Scotia and New Brunswick. These are nearly equal to the Boghead cannel in the amount of gas they produce, though not so free from impurities. Some of the Kentucky coals are also used to good advantage. The specific gravity is not depended upon as a certain test of the quality of the gas, the density of which may be increased by presence of impure heavy gases, or even of atmospheric air; but it is resorted to only as an indication in the absence of more exact tests.



The coke obtained from the retorts amounts to about forty bushels to the ton of coal; ten bushels are required for the fires beneath, and the rest is sold. As the volatile products pass through the hydraulic main, the principal portions of the oily and ammoniacal compounds are deposited in it; but some of these pass on in vapors, and would, if not separated, cause obstructions in the pipes in which they might condense in liquids and solids. These are consequently passed through a succession of tall iron pipes standing in the open air, and sometimes kept cool by water trickling down their outside. A pipe from the bottom of each pair conveys the condensed tar and ammonia into a cistern in the ground. Formerly the gas was still further condensed by passing it into the bottom of a tower filled with bricks, stones, etc., among the interstices of which it found its way up, while water was constantly sprinkled on the top and trickled down to keep the whole cool. This water removed the ammonia, but it also carried off some of the richest hydrocarbons, and consequently the wet scrubber, as it was called, was generally abandoned for other methods of condensing, in which the water was dispensed with. The gas made its exit from the top of the scrubber; and its passage being already somewhat impeded so as to throw considerable pressure back into the retorts, thus effecting chemical changes in the gas, which impaired its quality, it was found necessary to introduce a revolving exhauster, which took off this pressure, and at the same time propelled the gas forward into the succeeding apparatus. This was a purifier, the object of which was to arrest the carbonic acid and sulphurous gases. Dry quicklime, and also the solution of this in water, known as milk of lime, have the property of absorbing these gases as they are made to pass among the particles of the one spread upon shelves, or interspersed among a porous substance such as dry moss; or to bubble up through the aqueous solution. The lime as it became saturated with the impure gases was replaced with fresh portions.

The cleansing process was now complete, and the gas in proper condition to be delivered to the consumer. It must first, however, be measured, that a record may be kept of the quantity produced, and it was next conducted into the great gas-holders in which it was stored. The measurement was effected by means of a large station meter, constructed on the principle of the small service-meters, with one of which each consumer is supplied. A revolving drum with four compartments of equal capacity is made to rotate in a tight box by the gas entering and filling one of these compartments after another. Their capacity being known, and the number of revolutions being recorded by a train of wheel-work outside the box, the quantity of gas which passes through is indicated with moderate accuracy. The largest meters pass about 650 cubic feet by one revolution of the drum, or about 70,000 cubic feet in an hour.

The gas-holders are the large cylindrical vessels of plate iron, the most conspicuous objects at the gas works. Each one is set with its open end down, and immersed in a cistern of water of diameter a little exceeding its own. It is buoyed up by the water, and also counterbalanced by weights passing over pulleys. The gas admitted under the inverted cylinder lifts this up, and fills all the portion above the water. The weight of the cylinder when the influx is shut off and the discharge pipes are opened presses the gas out and through the mains to the points where it is consumed. The gas-holders of the largest works are of immense size. In Philadelphia, there is one 160 feet in diameter, and 95 feet high, holding 1,800,000 cubic feet of gas. Even this is exceeded by one at the Imperial Gas Company's works, London, which is 201 feet in diameter, 80 feet high, and of the capacity of 2,500,000 cubic feet. This cost upward of $200,000, and contains 1,500 tons of iron, 5,000 cubic feet of stone work, and 2,000,000 bricks. No advantage is gained in a single structure of this immense size over several smaller ones. On the contrary, this involves heavy expenditures to protect them against the force of the wind, and render them manageable. Those of great height are made in sections, which shut one within another in descending, like the parts of a telescope. As each section is lifted in turn out of the water, its lower edge, which is turned up in an outward direction, forming an annular cup, includes a portion of water, into which the upper edge of the next lower section catches, being turned over inward for this purpose. A gas-tight joint between the two sections is thus formed.

To insure uniformity of pressure, as the gas enters the mains it is first made to pass through the apparatus called a governor, in which, according to the force or slowness with which it moves, it causes a valve to rise and partially close an aperture within the machine through which the gas flows, or to descend and open this aperture. The increase of pressure as the gas is carried to higher levels, amounting to one-fifth of an inch of water in every thirty feet, renders it important in hilly towns to have governors upon different levels. In high buildings a very sensible difference is perceived in the force with which the gas issues from the burners on the different stories. This involves a waste of gas where the pressure is great, for under such conditions a considerable portion of that consumed adds little to the illuminating effect. Various governors or regulators have been devised for the use of consumers with a view of producing an increase of light with reduced consumption of gas; and when judiciously applied, some of them have proved very successful. They have been introduced into some of the public buildings of New York city, controlled by the Street Department, and according to the report of the Street Commissioner, the saving has been very remarkable.

Each consumer of gas is supplied with a meter, which is under the control of the gas company; and from its indications the amount furnished is determined by inspection every month.

Though in the use of gas the consumer is in a great measure dependent on the manufacturer as regards the economy of the light, there are several points, by giving personal attention to which, he may more fully realize the saving it affords. In the first place, he must be aware that every one employing this source of light uses it more freely than that derived from lamps and candles. It is enjoyed with so little trouble and apparent cost, that much more light is soon regarded essential than was perfectly satisfactory under the old methods of producing it. He should next see that the area of the delivery pipe bears such proportion to the quantity usually required, that there is no undue pressure upon the burners, as it is evident when the gas "blows" through them as it burns. This should be checked by shutting off a part of the supply by means of the stop-cock at the meter; and this should be looked to after every visit of the gas man to the meter. The regulator also is intended to remedy this over supply, but it may still be necessary to keep part of the gas turned off, and by so doing the regulator may be dispensed with. Attention should next be directed to the burners, that those of largest size, such as consume with the ordinary pressure six feet or more of gas an hour, should be placed only where the greatest quantity of light is required, and that burners of four feet, three feet, two feet, or even one foot an hour, be placed where the light they give will be sufficient. A great variety of burners have been contrived, and some of them are highly recommended for affording more light with the same amount of gas. All, however, are liable to become foul after a time, and should be occasionally cleaned or replaced. The iron of which they are made is corroded by the ingredients of the gas, especially when not in use, and air entering, its elements form acid compounds with those of the gas, which remain in the open portion of the pipe. The argand burner is recommended for the powerful and steady light it gives, but it is far from being economical, and moreover produces great heat.

The quality of gas is determined either by analysis, or more conveniently by testing with the photometer its comparative capacity of producing light. The standard adopted for comparison is spermaceti candles, each one burning 120 grains in an hour. An argand burner consuming five feet of gas an hour (the quantity carefully proved by the meter) is used in making the trial; and the number of candles required to produce an equal amount of light indicates the quality of the gas. At the points of consumption, this is sometimes inferior to that of the gas at the works before it enters the gas-holders and passes through the mains; and in very cold weather, by the condensation of the richest hydrocarbon vapor in the pipes, the gas that reaches the burners is much poorer than that which left the works. Consequently these facts should be taken into consideration in estimating the quality of gas furnished by any establishment. Again, after a period of excessive cold weather, when the gas has burned dimly by the condensation of its best portions in the pipes—it may be to the extent at times of obstructing the flow through them—and with the return of milder weather the vapors are released and mix with the new gas, they sometimes so overburden this with an undue proportion of the richest compounds, that with the ordinary burners the gas cannot be consumed, and the result is a smoky flame, of which the consumers make great complaint, believing it to be caused by inferior gas. Such are some of the causes, over which the manufacturers have no control, that involve more or less irregularity in the quality of the gas supplied.

The gas produced at different works is of various qualities. That of the Manhattan Gas Light Company is rated at sixteen candles, though probably seldom reaching twelve, and is perhaps as good as any furnished in our cities. It is tested daily with the photometer at their office. In England, the gas of the London works varies from eleven to eighteen candles. That of Liverpool is much better, sometimes being equal to twenty-two candles.

Other materials than coal have been applied to some extent in the United States for producing gas chiefly for small supplies for single buildings. The most successful of these processes is that with rosin oil. The apparatus is exceedingly simple, and is placed in an apartment in an out-building. It consists of a stove containing a chamber in the top, into which the rosin oil is allowed to drop slowly. It is decomposed by the heat of the surface upon which it falls, and the gaseous products pass immediately through the pipes into the gas-holder, whence they are distributed as at the large gas works. The supply for a week may be made in less than an hour with very little attention from the person in charge. The gas is superior to that from coal, and the expense, not reckoning the cost of the gas-holder and the apparatus, is less than the price ordinarily paid for gas.

In Philadelphia, wood has been successfully used at the Market street bridge works. Six retorts have been kept in operation with it for some time, and the yield and quality of the gas have proved very satisfactory. As in the use of coal, it is found necessary to charge the material into retorts already at a high heat, otherwise the gaseous products have little illuminating power. Gas thus made from pine wood has been found to contain 10.57 per cent. of olefiant gas, and that from oak 6.46 per cent.

HYDROCARBON GAS.—What is known as the hydrocarbon or water gas manufacture was introduced into Philadelphia in 1858, and according to the published reports, its application for lighting a portion of the Girard House proved perfectly satisfactory. It was introduced into the town of Aurora, Indiana, in January, 1861, and according to the statements published in the Cincinnati *Daily Commercial*, the operation had been very successful. The light is described as very brilliant, and the gas almost free from odor. The process appears to be similar to that of Mr. White, of Manchester, England, which consists in the generation of non-illuminating gases by the action of steam upon charcoal highly heated in a retort, the aqueous vapor being thereby decomposed, and various gaseous compounds produced by its hydrogen and oxygen combining with the carbon of the charcoal. If the operation is properly conducted these compounds should be almost entirely carbonic oxide and free hydrogen; if carbonic acid is produced, as it may well be, even to the extent of one per cent., it may involve the expense of purification by means of a lime purifier. These gases are immediately passed through another retort, in which the illuminating gases are generated, and mixing with them the whole is immediately swept forward out of the reach of the high decomposing temperature. The material employed for furnishing the illuminating gas is either rosin or rosin oil gradually dropped into the heated retort; and it is stated that various other carbonaceous substances, as the tar from the gas works and cheap greasy compounds, may be economically applied.

Although this method of producing gas has been highly recommended by eminent English authorities, especially by Dr. Frankland, an account of whose experiments and conclusions is given in a recent edition of Ure's Dictionary, it has not been adopted by gas companies, whose first interest it would be to avail themselves of such improvements, and it is reasonable to suppose there are some insuperable objections to it. Indeed, in the last edition of Clegg's "Treatise upon the Manufacture and Use of Gas," the subject is passed by with scarcely any notice, although it had been in the previous edition treated in detail and with commendation. In the English *Gas Journal* it it decidedly condemned. No analyses of the gas thus produced in this country have ever been published, nor any reports of photometrical experiments that might establish its light-giving capacity. As the subject for some time attracted much attention, and has given rise to extravagant expectations of cheap production of gas, it is very desirable that such trials and reports should be made by some competent chemist. Some companies have been organized in our large cities for the manufacture of this "water gas," and they have been moderately successful. One in Brooklyn, and another in New York, are now furnishing it.

GAS FOR STEAMBOATS AND RAILROAD CARS.—Several methods have recently been put in practice for furnishing gas for the convenience of passengers in steam vessels, or upon railroads. One plan is to place in the boats or under the cars large cases of sheet iron, each one provided with a diaphragm or partition of india-rubber across its upper portion. A connection being made between the receptacle under the diaphragm and the street main, the gas fills this portion of the case and the connection is then shut off. When required for use, the gas is forced out by the pressure of air uniformly applied upon the upper surface of the india-rubber sheet by means of a meter running by clock work. This method has so far been successful; but danger is apprehended by some that atmospheric air may find its way through the flexible sheets, all of which are more or less permeable when used to separate different gaseous compounds, and that an explosive mixture may thus be introduced. By another plan of a New York company, the gas by means of force pumps is compressed into strong cylindrical gas-holders made like the boilers of steam engines. The gas is thus made to occupy a diminished space in proportion to the pressure used, that of twenty atmospheres placing 1,000 cubic feet of gas in fifty feet space. In Jersey City, where this method has been applied to furnishing gas for railroad cars, the pressure employed is about 450 lbs. upon the square inch. Under this pressure the gas is conveyed through pipes to the points where the cars receive from them their supplies. The gas by its elasticity presses through the burners, and uniformity of discharge while this force is constantly diminishing is secured by a governor or regulator constructed on the principle already described.

Gas for Fuel.—Besides its use for producing light, gas has long been applied to other domestic purposes for the sake of the heat it can be made to afford in burning. It was thus first used by chemists, and mechanics, as bookbinders, then applied it in suitable stoves to the heating of such tools as they required of a high temperature. After this stoves were contrived on different plans in which various culinary operations might be conducted, and some also for warming rooms. Though it would appear to be an expensive fuel, it has been found for many purposes, in which only a certain amount of heat is required, and this for a short time, not merely exceedingly convenient, but economical. No more need be consumed than is required to effect the desired purpose, and it is moreover applied directly to the object to be heated with little dispersion or waste of heat. But for warming rooms it is objectionable, not only on account of its cost, but also from its vitiating the atmosphere by the large amount of the noxious gases produced by its combustion. If these are conveyed away by ventilating flues, they carry with them a considerable portion of the caloric set free.

The general introduction of petroleum oils for illuminating purposes did not, at first, have much effect on the production of illuminating gas, because it was manufactured only in the larger cities, and was preferred to the somewhat malodorous "kerosene" by those who could have their choice. As, however, gas works were extended to the smaller cities and towns, there began to be a pretty active competition between the petroleum products and gas, and this in several directions. Naphthaline, gasoline, and other of the lighter and more explosive products of petroleum distillation and refining were used in the production of gas with small apparatus sufficient for the supply of a hotel, store, or private dwelling; but this was fraught with so many dangers that it never came into very general use. New lamps and burners with metallic or glass wicks were contrived for burning kerosene with less danger, and in the large cities many of the finest stores were fitted up with these lamps, which gave a better light at much less cost than gas, but the work of cleaning and filling them was irksome, and occasionally there were accidents, even in their most careful use. Yet they became sufficiently general to bring down the price of gas stocks nearly one half, and have made the business much less profitable than formerly.

But the most formidable competitor with gas is now, and is likely to be, the electric light. We shall have more to say in regard to this in another chapter, but it is sufficient to say here that the electric light has passed from the stage of possible and theoretical experiment into that of a great practical fact, and that with six or eight rival manufacturers, all with large capitals, great inventive genius, and dogged determination to accomplish all that can be accomplished by the most persevering effort, it is not possible that they should fail of achieving a great and permanent success. Already in all our large cities, many large stores, warehouses, churches, and public halls are lighted by it, and portions of the streets. There is need of simplifying and economizing the costly machinery now used for its production; need of rendering it less expensive than now, in order that it may be introduced generally into private dwellings; need of modifying the tone and color of the light, which is now too white and glaring; need of preventing the possibility of fire and accidents, which might prove fatal from the contact of the wires. But all these difficulties will be overcome by patient experiment, and the light of the future is destined to be the electric light, unless something still more perfect can be discovered or devised.

## CHAPTER XI.

### COAL OIL AND PETROLEUM.

Notwithstanding the substitution in the cities and most of the towns of considerable size throughout the country of gas for oils, the demand for the latter has increased much faster than the supply, as is shown by the price for sperm oil being very much higher than it was in 1843, when it brought about fifty-five cents per gallon. Besides its use for illuminating purposes, the consumption of oil is enormous for lubricating machinery. The railroads and steamboats, and the increasing numbers of large factories, demand such quantities of it that all the ordinary sources of supply were overtasked, and the whaling business formerly so prosperous in New England, has fallen off in the face of advancing prices, or been forced to gather itself in fewer centers. where by concentration of its operations the business could be conducted with the greatest economy. From many seaports of New England this business has quite disappeared, and even those which retained for some years their fleets of whaling ships have now almost abandoned the business. Nantucket, once the great center of the sperm whale fishery, has dwindled from year to year till now no ships are sent out from the island. The manufacture of lard oil, which for some years was extensively carried on in the western states, failed to meet the increasing demands, when at last attention began to be directed to the extraction of oils from the bituminous coals and shales, by processes which had been introduced from France and England. The success attained by Mr. James Young, of Glasgow, in his treatment of the "Torbane Hill mineral," or Boghead cannel of Scotland, served more than anything else to give encouragement to this enterprise. In 1854, according to the testimony of this practical chemist in a lawsuit in London, he was producing about 8,000 gallons a week of an oil he called paraffine oil, which sold for 5s. a gallon, the sales amounting in all to about $500,000 per annum, of which the greater portion was profit. Operations of a similar character had for some time previously been conducted upon a large scale at Autun, Department of the Saone and Doire, in France; the materials employed being highly bituminous shales, probably not essentially different from the Torbane Hill mineral, except in producing much less oil to the ton.

The first factory for making coal oil in the United States was established on Newtown Creek, Long Island, opposite New York city, and commenced operations in June, 1854. This was known as the Kerosene Oil Works, and was designed to work the Boghead cannel, or coal of similar character from the province of New Brunswick, or from the west, by the patented process of Mr. Young. In Kentucky, Ohio, Virginia, and Pennsylvania, cannel coals were found of suitable qualities for this manufacture; and in 1856 the Breckenridge Coal Oil works were in successful operation at Cloverport, on the Ohio river, in Breckenridge county, Kentucky. The same year a factory was built in Perry county, Ohio, by Messrs. Dillie and Robinson, and others rapidly sprung up in the vicinity of Newark, which soon became an important center of this new business. In 1858, several large factories were built in New England, one in Boston, and one in Portland, Maine. It is doubtful whether Young was the first inventor or discoverer of this, for. as we shall see, the late Baron von Reichenbach had many years before distilled some ounces of a naphtha from pit coal, which was substantially identical with Young's; and several other chemists claim to have arrived at similar results; but Young was certainly the first to produce the oil on a commercial scale.

So rapid was the increase in the demand for this oil, that in 1860 there were nearly eighty manufactories in the United States, employing over $3,000.000 capital, and producing oil, naphthalin, and paraffine to the amount of five millions of dollars annually. The coal oil manufacture had assumed at a bound an importance which gave it the leading place among the new manufactures of the previous decade. The production of illuminating oils exceeded in that year ten million gallons, and about five millions of gallons of the heavy lubricating oils and paraffine. The man who had predicted that within the next three years all this activity of production would cease, and another article then just coming into notice would supersede it, and attain to ten times its extent, would have been deemed little less than a madman. Yet this was precisely what happened.

### HISTORY AND METHOD OF THE MANUFACTURE.

The possibility of extracting oil from bituminous minerals appears to have been known since the year 1694, a patent having been granted in January of that year to Martin Eele, Thomas Hancock, and William Portlock, for "a way to extract and make great quantities of pitch, tarr, and oyle out of a sort of stone, of which there is a sufficient found within our dominions of England and Wales." This stone proved to be a bituminous shale; and in 1716 it was again applied to similar use under another patent, granted to M. & T. Belton, of Shrewsbury. In the course of the eighteenth century the oily product obtained was employed to some extent as a medicine, under the name of British or petroleum oil. Though from time to time other patents were granted in England for the same process, the business never became of importance until the successful trials were made by Mr. James Young, of Glasgow, upon the Boghead cannel already referred to. On the continent the subject was brought before the public by the researches of Baron von Reichenbach in 1829, '30, and '31, when he discovered and separated numerous new compounds from the products of the slow distillation of bituminous substances. The compound he named eupion is the same thing as the rectified oil since known as coal oil, paraffine oil, kerosene, photogenic, pyrogenic oil, and by other local or commercial names. He appreciated its useful properties, and recommended the prosecution of further trials with the object of establishing the best mode of separating it. In France, its character was understood in 1824, when a patent was granted for its manufacture; and in 1833 factories were in operation for producing it. In 1834 the method adopted by Selligue was first published, and in the specification of the patent granted to him, March 19, 1845, is a full account of the process as conducted in the works at Autun. This is still the best treatise published upon the manufacture, and notwithstanding the numerous patents which have since been issued, the improvements are limited to comparatively unimportant modifications of the apparatus. In the United States, the first patent granted in this manufacture was in March, 1852, to James Young for his process, which in this country was first introduced at the kerosene oil works on Newton Creek. In 1853 two patents were granted, in 1854 and 1855 one each, in 1856 six, in 1858 seven, and in 1859 twenty-two.

As mentioned in the preceding chapter, the products obtained by the distillation of bituminous substances vary according to the amount of heat employed and the manner of its application, whether sudden or gradual Coals thrown into red hot retorts are resolved into large quantities of gas, with the production of inconsiderable quantities of oily compounds heavier in the aggregate than water, and called coal tar. They consist of a variety of hydrocarbons, as the fluids designated by the name of naphtha, the white crystalline substance called naphthaline, the very volatile fluid benzole, besides carbolic acid and a great number of other curious and interesting compounds of hydrogen and carbon. In general they contain a less proportional amount of hydrogen than the products obtained by slow distillation, the fluids are denser, and their boiling points higher.

When the bituminous substances are gradually and moderately heated in retorts, the production of gas is small. the carbon and hydrogen separating chiefly in the form of oily compounds of a greenish color, the specific gravity of which is less than water. These compounds form what is called crude coal oil, and are similar in appearance and composition to the natural petroleum, or rock oil, obtained in some places from the earth, as will be described in the next chapter. Benzole and naphthaline, products of the other method of distillation, are found, if at all, as a result of the employment of too high heat, and instead of the latter the waxy or spermaceti-like substance called paraffine is generated and is held in solution in the oils, from which it may be separated by repeated distillations, and draining off through filters and pressing out the fluid portions of the concentrated residues, at the lowest available temperatures. The oily products are divisible into a great number of distinct compounds by means of repeated distillations, each one being carefully conducted at a certain degree of temperature, and the product which comes over at this degree being kept by itself. But in the large way they are separated into only three classes, which are distinguished as the light oils for lamps, the heavy oils which are suitable for lubricating purposes, and paraffine. Sometimes a mixture of the heaviest oils and paraffine is made use of and sold for wagon grease and such purposes; and the first products which come over in the distillation are kept by themselves, and sold under the name of naphtha (or incorrectly as benzole) to be used as a solvent for the resins, caoutchouc, etc., and for removing grease spots from fabrics.

The proportions obtained from a ton of coal or shale are very variable. The Boghead cannel yields, in well conducted operations, about 117 gallons of crude oil, from which the product of refined oil is about 60 gallons. It can be made to produce even 130 gallons of crude oil, containing a larger proportion of refined oil than the 117 gallons ordinarily obtained. The Breckenridge coal yields from 90 to 100 gallons of crude oil, and this 50 to 60 of refined oil. The Cannelton coal of Virginia is of similar quality to the Breckenridge cannel. The coals of Ohio run from 55 to 87 gallons of crude oils to the ton, and those of Darlington, Penn., from 45 to 55 gallons. Besides the oils there also come over from the retorts, as in the gas manufacture, a quantity of water rendered alkaline by the ammonia it holds. This collects at the bottom of the reservoirs into which the products are received, and the oil that floats upon the surface being removed the ammoniacal liquors are allowed to escape.

While the general plan of the operations is the same in all the factories, the apparatus is variously modified. By Mr. Young's process the coal was distilled in cast-iron ⌓-shaped retorts, like those employed in making gas, and the volatile products were passed by a worm through a refrigerator kept at a temperature of about 55° F. The oils as they condensed dropped from the end of the worm into a receiver. Many patents were granted in Europe and in this country for different kinds of retorts. Some were made of cylindrical form and set upright in the furnace; the charge was introduced at the top and drawn out, when exhausted, at the bottom; the volatile products making their exit either through pipes at the top or at different heights. Some were constructed of fire-clay instead of cast-iron. In order that the charge might be uniformly heated, revolving cylindrical retorts were contrived and patented, first in France many years ago, and afterwards in the United States. They were sometimes eight feet long and six feet diameter, suspended upon an axle at each end. They were charged through a manhole in the front end like the common horizontal retorts, and the vapors passed out through the axle at the opposite end, which was made hollow for this purpose. Retorts of the size named were charged with about a ton of cannel coal, and four such charges could be worked off in twenty-four hours. They revolved slowly, about twice in a minute, thus turning the charge over and causing it to be uniformly exposed to the fire beneath. At the Lucesco works, thirty miles above Pittsburg, on the Alleghany, ten large revolving retorts were put in operation, each one of the capacity of two and a half tons. They were recommended for the rapidity with which the process was conducted, and the large amount of oil obtained to the ton of coal while they continued in good order; and, on the other hand, it was objected to them that the coal was apt to be ground to powder, and the dust carried along with the vapors, obstructing the condensing worm and adding to the cost of purification. They were, moreover, expensive to construct and liable to get out of order.

By all these arrangements the fire which caused the expulsion of the volatile matters was outside of the retorts. But the same object was also attained by the use of ovens and pits similar to those used for producing charcoal and coke, in which the material operated upon was itself partially consumed, to generate the heat required to drive off so much of its volatile constituents as escaped combustion. Kilns thus designed for extracting coal oils were in use in this country and in Europe; and in Virginia, near Wheeling, the plan was adopted of distilling the coal or shale in large pits dug in the ground of capacity sufficient to contain one hundred tons of the raw material. These were covered with earth, and the fire being started at one end, the heat spread the volatile products forward, and they were drawn out at the opposite end by the exhausting action caused by a jet of steam, and received into suitable condensing apparatus. Some of the kilns were constructed to be fired at the bottom, and the vapors then passed upward through the charge, and conveyed in pipes from the top to the condensers. The kilns of the Kerosene Oil Company, patented by Mr. Luther Atwood, were made open at the top, and a downward draught through the charge, which was fired on the upper surface, was produced by a steam jet thrown into the eduction pipe that passed out from the bottom of the kiln. A partial vacuum was thus produced, causing a current of air to flow in from the kiln. At the works of this company there were eighteen of these kilns in shape like a circular lime kiln, built of ordinary brick and lined with fire-brick. They were twenty feet high and twelve feet diameter inside, each one having a capacity of over twenty-five tons of coal. When this amount of Boghead cannel was introduced it was covered with about four tons of Cumberland coal and a quantity of pine wood. This was set on fire, and at the same time the steam jet was let on. The heated gases from the combustibles above passed through the bituminous materials below; but little air reached these that was not already deprived of its power of sustaining further combustion. The volatile products were gradually expelled before the slowly increasing heat, and the operation was not completed till the expiration of four days. It was hastened or checked, as might be necessary, by means of the steam jet by which the draught was controlled. What was left in the kiln was unconsumed coal and ashes—no good coke was produced. The condensers at these works were tall cylinders of boiler-plate iron. Passing through a succession of these the vapors collected and trickled down their sides, and the mixed oily and aqueous products were received into iron vats placed in the ground. The uncondensable gases escaped into the open air from the top of the last of the cylinders. From the vats the oil rising to the surface flowed over into a conduit that led to a large cistern in the ground of the capacity of 40,000 gallons. The water at the same time was discharged by a pipe, one end of which was at the bottom of the vat, and the other was bent over its upper edge, the flow being caused by the difference of an inch in the elevation of the surface of the two vats. Some oil was carried over into the second vat, and this was separated by a repetition of the same arrangement, and so on through several vats, till the ammoniacal waters were finally allowed to escape after being first received into a large cistern, where some oil still collected upon the surface, and was removed by occasional skimming.

Still another method of conducting the dry distillation was by the introduction of highly heated steam into the retorts, as patented by Mr. William Brown, in 1853, in England and in this country, though this seems also to have been used in the original operations of Selligue in France. The effect of the steam was to aid in heating the charge, while at the same time the vapors were taken up and carried along by it, and protected from being burned or decomposed by remaining in contact with the hot surfaces of the retort. In the subsequent distillation of the crude oil high steam was similarly applied in the stills.

Nearly the same process of refining was practiced at all the factories. The crude oil was pumped up into large stills of cast or boiler-plate iron, with cast-iron bottoms two inches thick. The capacity of these at the works above referred to was 1,500 gallons each, and the time required for distilling off this amount of oil was twenty four hours. They were heated by fires of anthracite and coke, the latter being itself a product of the distillation and obtained from the inside of the stills after each heat. It was deposited from the crude oil, and formed a solid and extremely hard incrustation which was sometimes nearly a foot thick upon the bottom of the stills. It was a much superior coke to that obtained from the gas retorts, and in its structure was coarsely honey-combed in the upper or last formed portions, gradually growing closer and more compact toward the bottom upon which it adhered. The distillation was conducted at a temperature not exceeding 800° F., and the process was rendered continuous by admitting a small stream of oil into the stills. The vapors passing through the goose-neck were condensed in a long worm kept in the water condenser, which was, in the latter part of the distillation, at a temperature of 80° or more. It was necessary to guard against so low temperature as might cause the paraffine to solidify in the worm, which by stopping the flow of the products might result in blowing up the still. The heat was carefully regulated so that the oil came over uniformly, flowing from the end of the worm in a steady stream. It was still of a greenish color, with more or less of its peculiar, disagreeable odor. Yet it was evidently purified to a considerable extent by its separation from the free carbon and other impurities, usually amounting to 10 or 12 per cent., which were left behind in the stills. The oils were next pumped into large cylindrical cisterns, called agitators, to undergo the chemical treatment, which was in general the same as that practiced by Selligue. An addition was made to them of a quantity of sulphuric acid, perhaps to the amount of 5 per cent. The mixture was then violently agitated or made to sweep rapidly round by stirrers in the cisterns, moved by machinery. The pure oil and paraffine were unaffected by the chemical agents, but the carbonaceous particles and coloring matters were more or less charred and oxidized, and their condition was so changed that when the mixture was left for some hours to repose, they subsided in great part together with the acid, and these could then be drawn off leaving the partially purified oil in the upper portion of the cisterns. This was next washed with about one-fifth its quantity of water, which removed the soluble impurities and a portion of the remaining acid. These, after subsiding, being drawn off, a strong lye of potash or soda was introduced into the oil, which neutralized and fixed what acid remained, and caused the precipitation of further portions of the coloring and tarry matters. The mixture was again agitated, and was then left six hours to repose, after which the sediment being drawn off, it was again washed with water, and this, too, with the matters it had taken up, were drawn off. In some places chalk or lime was employed instead of the alkaline lye to neutralize and fix the acid, and the chemical treatment, as it was called, was in other respects variously modified. Though this has been designated the "cold" treatment, the temperature was not allowed to fall below 90° during these processes.

At last the oils freed from most of their impurities were introduced into stills like those of the first set. The product which first came over was a very light oil somewhat discolored, which was soon followed by a clear oil having little odor. This gradually increased in density from 0.733 to 0.820, up to which point the mixture of oils was classed as illuminating, and was without further preparation sufficiently pure to be at once barrelled for the market. After this the increasing depth of the color and the greater density of the product indicated that the light oils had been nearly exhausted, and the remaining portions were hence kept by themselves to afford the heavy lubricating oils, and also it may be, by means of fractional distillation, the additional quantities of light oils they still contained, and, finally, the paraffine which was chiefly concentrated with the last portions. This substance when separated from the oils by filtration and pressure at low temperatures, was of a dark color and somewhat offensive odor; and to bleach and deodorize it proved to be somewhat troublesome and expensive operations. Exposure to the sunlight has a bleaching effect; but the processes for this purpose were not made public for some years. When obtained perfectly pure and white, difficulties were encountered in running it into candles, which were not common to other materials used for this purpose. When cooled in ordinary moulds the paraffine would crack in lines radiating from the wick, and the exterior would present a clouded, mottled surface. The method of obviating this difficulty, as described in the French work, "Le Technologiste," of 1859, was to use a mould in two parts, that part for the point of the candle working in the other like a piston. These moulds being brought to the temperature of melted paraffine were filled and then immediately plunged into water at nearly the freezing point. Having remained three or four minutes, they were taken out and exposed to a current of cool air for fifteen or twenty minutes. The candles then came out, as the movable part of the mould was pushed in, free from defects. This method was successfully introduced into the United States. Paraffine candles were made at some of the coal oil works, as at those of New York, New Bedford, and Portland. They were of beautiful appearance, resembling the best sperm candles, and at the same time were more economical for the amount of light they afforded. The oil that was pressed out from the paraffine was useful chiefly as a lubricator, and from the low temperature at which it was obtained, if for no other reason, it was insured against chilling in cold weather. The residue in the stills was a mixture of the tarry matters with the portion of the chemical ingredients that was introduced with the oils. For this no use was found. The heavy oils found their principal application in lubricating machinery, and large quantities were consumed for this purpose upon the Western railroads. The heavier natural oils of Ohio, when washed clean from the sand that came up with them, were also very well adapted for this use; but it was found advantageous to mix either the crude or manufactured article with an equal quantity of lard oil. The petroleum corrected the tendency of this to gum and chill, while it received additional body from the lard oil. Another use for the heavy oils was for cleansing wool in the woolen factories, and where they were tried for this purpose they were preferred to other oils. In currying leather, also, they were said to have proved a good substitute for fish oil. Experiments were made with them in Ohio for mixing paints, and the crude heavier kinds, as those of Mecca, treated in the same manner as linseed oil, boiling them with dryers, etc., formed a good body, covered the wood well, dried rapidly and perfectly, and formed a smooth, hard surface, retaining no odor. The great abundance of the supply of petroleum in Pennsylvania and Ohio induced some speculation as to the probability of the hydrocarbon oils being used for fuel for steamboats, locomotives, and wherever a highly concentrated, portable, and manageable fuel was required. For domestic uses, also, such as required a fire only a little while at a time, the coal oils were conveniently used in suitable stoves in the same manner that gas was applied to the same purpose. But experiments were wanting to establish the rate per gallon at which it might enter into competition with other fuels upon a larger scale. Besides the heavy and light oils, no other valuable products resulted from the distillation of the coal oils. Benzole is said not to be a product of this process. It belongs, together with a special class of hydrocarbons designated as the benzole series, to the tar of the gas works; and if ever obtained in the coal oil distillation, it was declared that it must be by bad management and the use of excess of heat. It was found, after the discovery and practical adoption of the petroleum as an illuminating fluid, that from this, by the refining and distilling processes, not only benzine but naphtha and other still more volatile hydrocarbons were produced, and the principal difficulty in reducing the petroleum to a safe and non-explosive illuminator was to rid it of these very volatile oils. It is probable that they did exist in nearly the same form in the coal oils, but had not been skillfully eliminated at first.

The lighter coal oils were superior in many respects to most of the articles previously used for purposes of illumination. Their odor, though not very agreeable, was better than that of most of the sperm or lard oils, and the spots made by spilling them on articles of dress or furniture were removed with less difficulty than those of the fatty oils. They were also far less liable to explosions than the so-called "burning fluids," which were previously in very general use, but were constantly producing terrible accidents and loss of life. They were, if burned in properly constructed lamps, much less disagreeable and liable to smoke than camphene.

But the reign of the coal oils for purposes of illumination was destined to be of short duration; for petroleum, or, as it came to be called, when refined for illuminating purposes, "kerosene oil," became so abundant in 1861 and 1862, and received such an extensive development, that the distillation of oil from coals, both for illuminating and lubricating purposes, almost ceased after 1863. An effort was, indeed, made in 1863 and 1864 to distil these oils on a large scale from the bituminous shales of Kentucky; but though the material could be had at the cost of breaking it up, and the process of distillation was very simple, the flowing wells of western Pennsylvania and West Virginia furnished crude petroleum so cheaply that this undertaking proved unprofitable.

## CHAPTER XI..

### PETROLEUM, OR ROCK OIL

The occurrence of an oily fluid oozing in some regions from the surface of the earth, coming out with the springs of water, and forming a layer upon its surface, has been noticed from ancient times, and the oil has been collected by excavating pits and canals, and also by sinking deep wells. The asphalt ("slime" of the Old Testament) used in the construction of the tower of Babel (Gen. xi, 3) and the city of Nineveh was an asphaltic mortar, the asphalt for which was a partially evaporated petroleum. This was obtained from the springs of Is, on the Euphrates, and to this day it is used to supply the neighboring villages with oil. Zante, the Ionian islands, and Agregentum in Sicily have all had oil wells yielding a large amount for more than 2,000 years.

The wells of Amians, on the banks of the Taso, formerly supplied oil with which the city of Genoa was lighted. Baku, a town on the west side of the Caspian Sea in Georgia, has long been celebrated for its springs of a very pure variety of petroleum or naphtha, and the annual value of this product, according to M. Abich, is about 3,000,000 francs, and might easily be made as large again. Over a tract about 25 miles long and half a mile wide, the strata, which are chiefly argillaceous sandstones of loose texture, belonging to the medial tertiary formation, are saturated with the oil, and hold it like a sponge. To collect it large open wells are sunk to the depth of 16 to 20 feet, and in these the oil gathers and is occasionally taken out. That obtained near the centre of the tract is clear, slightly yellow, like Sauterne wine, and as pure as distilled oil. Toward the margins of the tract the oil is more colored, first a yellowish green, then reddish brown. In the environs of Baku are hills of volcanic rocks through which bituminous springs flow out. Jets of carburetted hydrogen are common in the district, and salt, which is almost always found with petroleum springs, abounds in the neighborhood.

Another famous locality of natural oils is in Burmah, on the banks of the Irrawaddy, near Prome. Fifty years ago it was reported there were about 520 wells in this region, and the oil from them was used for the supply of the whole empire and many parts of India. The town of Rainanghong is the center of the oil district, and its inhabitants are chiefly employed in manufacturing earthen jars for the oil, immense numbers of which are stacked in pyramids outside the town, like shot in an arsenal. The formation containing the oil consists of sandy clays resting on sandstones and slates. The lowest bed reached by the open wells, which are sometimes 60 feet deep, is a pale blue argillaceous slate. Under this is said to be coal (tertiary?) The oil drips from the slates into the wells, and is collected as at Baku. The annual product is variously stated at 412,000 hogsheads, and at 8,000,000 pounds.

The Burmese petroleum has been largely imported into Great Britain, and is employed at the great candle manufactory of Messrs. Price & Co., at Belmont and Sherwood. It is described as a semi-fluid naphtha, about the consistence of goose grease, of a greenish brown color, and a peculiar, but not disagreeable odor. It is used by the natives, in the condition in which they obtain it, as a lamp-fuel, as a preservative of timber against insects, and as a medicine. It is imported in hermetically-closed metallic tanks, to prevent the loss of any of its constituents by evaporation. At the works it is distilled first with steam under ordinary pressure, and then by steam at successively increasing temperatures, with the following results :—

| Temperature. Fahr. | Proportional product. | Character of product. |
|---|---|---|
| Below 212° | 11 | Mixture of fluid hydrocarbons free from paraffine. |
| 230° to 293° | 10 | " " " containing a little paraffine. |
| 293° to 320° | .. | Distillate very small in quantity. |
| 320° to 612° | 20 | Containing paraffine, but still fluid at 32°. |
| About 612° | 31 | Product which solidifies on cooling, and may be submitted to pressure. |
| Above 612° | 21 | Fluids with much paraffine. |
| | 3 | Pitchy matters. |
| | 4 | Residue of coke, and a little earthy matter in the still. |

Nearly all the paraffine may be separated from the distillates by exposing these to freezing mixtures; and the total product of this solid hydrocarbon is estimated at 10 or 11 per cent.

Other localities might be named which furnish these oils upon a less extensive scale, as in Italy, France, Switzerland, and Germany. In Cuba impure varieties of bitumen are met with flowing up through fissures in the rocks and spreading over the surface in a tarry incrustation, which sometimes solidifies on cooling. In the island of Trinidad, three-fourths of a mile back from the coast, is a lake called the Tar Lake, a mile and a half in circumference, apparently filled with impure petroleum and asphaltum. The latter, more or less charged in its numerous cavities with liquid bitumen, forms a solid crust around the margin of the lake, and in the center the materials appear to be in a liquid boiling condition. The varieties contain more or less oil, and methods have been devised of extracting this; but the chief useful applications of the material seem to be for coating the timbers of ships to protect them from decay, and in furnishing the asphaltum used in France and the United States for pavement and for roofing purposes. By a process invented by Messrs. Atwood of New York the asphaltum was twice distilled, then subjected to treatment with sulphuric acid and an alkali, and further purified by permanganate of soda. A third distillation yielded an oil of specific gravity 0.900, fluid at 32° F., and boiling at 600° F.

In the United States the existence of petroleum has long been known, and the article has been collected and sold for medicinal purposes; chiefly for an external application, though sometimes administered internally. It was formerly procured by the Seneca Indians in western New York and Pennsylvania, and was hence known as Seneca or Genesee oil. At various places it was recognized along a belt of country passing from this portion of New York across the north-west part of Pennsylvania into Ohio. In the last-named state it was obtained in such quantity in the year 1819, by means of wells sunk for salt water, that it is a little remarkable the value of the material was not then appreciated, and the means perceived of obtaining it to any amount. The following description of the operations connected with the salt borings then in progress on the Little Muskingum, in the south-western part of the state, written in 1819, was first published in the *American Journal of Science* in 1826: "They have sunk two wells which are now more than 400 feet in depth; one of them affords a very strong and pure water, but not in great quantity. The other discharges such vast quantities of petroleum, or as it is vulgarly called, 'Seneka oil,' and besides is subject to such tremendous explosions of gas, as to force out all the water and afford nothing but gas for several days, that they make but little or no salt. Nevertheless, the petroleum affords considerable profit, and is beginning to be in demand for lamps in workshops and manufactories. It affords a clear bright light, when burnt in this way, and will be a valuable article for lighting the street lamps in the future cities of Ohio." Several coal-beds were penetrated in sinking these wells. In several of the southwestern counties of New York, the existence of petroleum and its products has been well known for more than 60 years. In Chautauqua county, the hydrogen gas springs which furnish light to half the village of Fredonia, and more recently have come to the surface at another point, where they yield a much larger supply, are known to proceed from the lighter and more gaseous portions of petroleum deposits of a reservoir nearer the surface than most of those in Pennsylvania.

In north-western Pennsylvania the existence of oil in the soil along the valleys of some of the streams was known to the early settlers. One stream, in consequence of its appearance on the banks, was called Oil Creek. In other localities also it was noticed, and several flowing oil wells were in operation between 1829 and 1836 at some places in western Virginia and eastern Kentucky. At Tarentum above Pittsburg, oil was obtained by boring about the year 1845. Two springs were opened in boring for salt, and they have continued to yield small quantities of oil, sometimes a barrel a day. This has been used only for medicinal purposes. On Oil Creek two localities were especially noted, one close to the northern line of Venango county, half a mile below the village of Titusville, and one 14 miles further down the stream, a mile above its entrance into the Alleghany river. All the way below the upper locality through the narrow valley of the creek are ancient pits covering acres of ground, once dug and used for collecting oil after the method now practiced in Asia. One of these at Titusville was found, after it was cleared out, to have been 27 feet deep and 5 or 6 feet in diameter, and to be cribbed up with logs to the top. In another, a notched tree was found still standing in the position in which it had been used as a ladder. This kind of ladders were used by the Aztec and Pueblo Indians in their mines in the west. It was at first supposed that these wells had been dug by whites, during the French occupation of that country, but that idea was negatived by the fact that upon the earth thrown out in digging the wells, or in the wells themselves, trees were growing which were from 500 to 1,000 years old. They were probably dug by the mound builders, who are now supposed to have been contemporaries of the Toltecs, and to have occupied this region about the 5th or 6th century. It seems, however, from Day's "History of Pennsylvania," that the Seneca and perhaps other Indian tribes knew of these wells and used the oil as an unguent and in their religious worship. They mixed with it their paint with which they anointed themselves for war; and on occasions of their most important assemblages, as was graphically described by the commandant of Fort Duquesne in a letter to General Montcalm, they set fire to the scum of oil which had collected on the surface of the water, and at sight of the flames gave forth triumphant shouts which made the hills re-echo again. In this ceremony the commandant thought he saw revived the ancient fire worship, such as was once practised in Baku, the sacred city of the Guebres or Fire Worshipers.

The old maps of this portion of Pennsylvania indicate several places in Venango and Crawford counties where oil springs had been noted by the early settlers. They made some use of the oil, collecting it by spreading a woolen cloth upon the pools of water below the springs, and when the cloth was saturated with the oil wringing it out into vessels. The two springs referred to on Oil Creek furnished small quantities of oil as it was required, and from a third, twelve miles below Titusville in the middle of the creek, the owner has procured 20 barrels or more of oil in a year.* In 1854 Messrs. Eveleth and Bissell of New York purchased the upper spring, and leased mineral rights over a portion of the valley. They then obtained from Prof. B. Silliman, jr., of New Haven, a report upon the qualities of the oil, and in 1855 organized a company in New York called the "Pennsylvania Rock Oil Company," to engage in its exploration. The same year a new company under the same name, formed in New Haven and organized under the laws of Connecticut, succeeded to the rights of the old company; but for two years they made no progress in developing the resources of the property they had acquired. In December, 1857, they concluded an agreement with Messrs. Bowditch and Drake of New Haven to undertake the search for oil. To the enterprise of Col. G. L. Drake, who removed to Titusville and prosecuted the business in the face of serious obstacles, the region is indebted for the important results which followed. After a well had been sunk and curbed near the spring, ten feet square and sixteen feet deep, boring was commenced in the spring of 1859, and on the 26th of August, at the depth of seventy-one feet, the drill suddenly sank four inches, and when taken out the oil rose within five inches of the surface. At first a small pump threw up about 400 gallons daily. By introducing a larger one the flow was increased to 1000 gallons in the same time. Though the pumping was continued by steam power for months no diminution was experienced in the flow. The success of this enterprise produced great excitement, and the lands upon the creek were soon leased to parties who undertook to bore for oil for a certain share of the product, sometimes advancing besides a moderate sum to the owner.

The country was overrun by explorers for favorable sites for new wells, and borings were undertaken along the valley of the Alleghany river, and up the French Creek above Franklin. The summer of 1860 witnessed unwonted activity and enterprise in this hitherto quiet portion of the state, where the population had before known no other pursuits than farming and lumbering. Every farm along the deep, narrow valleys, suddenly acquired an extraordinary value, and in the vicinity of the most successful wells villages sprung up as in California during the gold excitement, and new branches of manufacturing were all at once introduced for supplying to the oil men the barrels required for the oil and the tools employed in boring the wells. From Titusville to the mouth of Oil Creek, about 15 miles, the derricks of the well borers were everywhere seen. On the Alleghany river the number below Tidioute in Warren county, south into Venango county, showed that this portion of the district was especially productive, and the same might be said of the vicinity of the town of Franklin, both up the Alleghany river and French Creek. The wells had amounted to several hundred, or according to one published statement, to full 2000 in number before the close of the year, and from an estimate published in the *Venango Spectator*, (Franklin) 74 of these on the 21st of November, 1860, were producing the following daily yield:—

*See a pamphlet by Thomas A. Gale, published in Erie, Penn., 1860, entitled "Rock Oil in Pennsylvania and elsewhere."

| | No. of wells. | Prod. bbls. |
|---|---|---|
| On Oil Creek, | 33 | 485 |
| " Upper Alleghany river, | 20 | 442 |
| Franklin, | 15 | 139 |
| Two Mile Run, | 3 | 64 |
| French Creek, | 3 | 35 |
| Total, | 74 | 1165 |

The capacity of the barrel is 40 gallons, and at the low estimate of only 20 cents the gallon the total value of the daily product was not far from $10,000. The depth of the wells was in a few instances less than 100 feet. The shallowest one reported, belonging to the Tidioute Island Oil Company, was 67 feet deep, and its product was 30 barrels a day. In general the depth was from 180 to 280 feet; one well in Franklin was 502 feet in depth, and one on Oil Creek 425 feet. The deepest wells were not the most productive, and the fact of their being extended beyond the ordinary depths was generally considered an evidence of their failure to produce much oil. There were exceptions, however, to this, one of the deepest wells, that of Hoover and Stewart, three miles below Franklin, producing largely of excellent oil.

By far the most extensive deposits of petroleum occur in N. W. Pennsylvania in the counties of Venango. Mercer, Crawford, and Warren. Within the last few years, it has been discovered that what is known as the Bradford district in McKean county, the next county east of Warren, had extensive deposits of a very fine oil, and many hundred wells have been bored there. In 1878, it was discovered that the southwestern portion of Alleghany county, New York, northeast of the Bradford district, was also rich in oil; and now there are 600 or more producing wells there (on Honeoye, Little Genesee, and Dodge Creeks, affluents of the Alleghany river). These yield nearly 13,000 barrels a day. More than three-fourths of all the petroleum of commerce comes from this region. Other districts which furnish considerable quantities are: the Mecca, Grafton, Vermillion, and Mapew valleys, in Ohio; Smith's Ferry on the boundary between Ohio, West Virginia, and Pennsylvania; Parkersburg, W. Va.; Glasgow and Burkesville, Ky.; Enniskillen and Gaspé, Canada; Sweetwater and Carbon Counties, Wyoming; the Tar Springs in Colorado; Bear Lake County, Idaho; Iron and perhaps other counties in Utah; Santa Barbara and Humboldt counties in California. The specific gravity, and sensible properties of the petroleum from these localities, differ, in a very marked degree, in part, perhaps, from their geological position, and the variety of organic animal and vegetable matters from which they have exuded. They are found in every geological horizon from the lower Silurian to the Tertiary. The Pennsylvania, Ohio, and Canada deposits, are in the Devonian, though in different strata of it. The West Virginia and southeastern Ohio, are probably in the lower coal measures; the North Carolina deposits, which are small, are in the Triassic strata; that of California and most of the western states and territories is in the Cretaceous and lower Tertiary, while that of Trinidad, of Italy, Germany, and Baku and Burmah are generally in the Miocene strata of the Tertiary.

Another cause of this difference is found in the different vegetable and animal tissues from which they are evolved. The Carboniferous and Devonian formations were deposited in eras of immense vegetable development, mainly of the palms, ferns, etc., and much the largest quantity of American oils is obtained from these formations. In this there is less of animal matter than in the rocks of a later age, and the oils are generally lighter and more volatile. This may be due also in part to the fact that in these rocks there are immense reservoirs between the strata, which are so completely closed to the air, that the lighter oils accumulate there in such quantities and under such pressure, that when they are reached by the boring tools, they will sometimes throw the boring tools and a continuous jet of oil, one hundred feet or more into the air.

There is also a great difference in the density, volatility, and vaporizing point of the different oils, and though all are hydrocarbons, yet the proportions of carbon and hydrogen differ, as do the products which can be obtained by distillation from them. The lighter oils belong chemically to the marsh-gas series, in which the proportion of carbon in 100 atoms ranges from 82.80 to 84.90 and of hydrogen from 17.20 to 15.10. The heavier oils belong to the ethylene series, whose composition is very uniformly 85.71 carbon, and 14.29 hydrogen. The boiling or vaporizing points of these various compounds range from 34° F. to 698° F. They are known by the names of naphthalene, gasolene, naphtha, benzine, the various grades of illuminating kerosene, astral oils, etc., to the lubricating oils, paraffine, malthas, bitumen, and asphalt. The selection of localities which was originally almost a matter of chance is not so now. It is well understood in any formations known to be oil-bearing, between what strata the oil is likely to be found, and though the system of crevices and previous strata through which the oil flows in its subterranean currents, is very irregular and often interrupted, and the strata themselves are of varying thickness, yet in certain localities the reservoirs are pretty certain to be reached within a few feet more or less.

It is not to be denied, however, that a well which may be near other productive wells, and may have been bored in full accordance with the most positive indications for reaching the subterranean oil reservoir may prove to be a dry well; the strata at that point may have been brought together so closely as to admit of no crevice or shallow place for a reservoir. But so thoroughly have the strata been traced in all their curves and dips that such accidents are much less common now than they were at first. The oil does not appear to be spread out, as the rocks lie in horizontal sheets, or if so there are many places where it does not find its way between the strata, and wells near together from which oil is pumped do not always draw upon each other. The valleys to which the early operations were limited, were narrow, and were bounded on each side by hills, the summits of which, from 250 to 400 feet above the bottoms, were on the general level of the country. The increased expense that would be incurred in sinking from the upper surface and in afterward raising the oil to this height, as also the uncertainty of finding oil elsewhere than in the valleys, prevented the explorations from being extended beyond the creek and river bottoms; but it was not long before the capacity of the broad districts between the streams to produce oil was thoroughly tested. At first the most favorable sites were supposed to be near a break in the hills that formed the margin of the valley, as where a branch came into the main stream. An experiment was undertaken to test the high grounds west of Tidioute branch, which proved successful.

As the bituminous coals are known as a source of hydrocarbon oils, it was natural to suppose that the springs of oil found near the coal region were fed from the coal-beds or bituminous shales of the coal formation. But it happens that only a few oil springs of western Pennsylvania have been struck in the coal-measures themselves, and that some of these are sunk into the underlying groups of rock to reach the supplies of oil. The oil districts are in general outside of the coal-field and upon the outcrop of lower formations which pass beneath the coal-measures, the whole having a general conformity of dip. Hence the slope of the strata is toward the coal, and an obstacle is thus presented to the flow of the oil from the coal-field toward its margin; and though under some circumstances the elastic pressure of the carburetted hydrogen gas might force the oil considerable distances from its source, it was hardly to be supposed that this should first find its way down into lower formations and then be carried many miles (30 to 50) and find its outlet in another district, rather than to the surface at some nearer point. The strata of northwestern Pennsylvania lie nearly horizontally, their general inclination being toward the south. The highest rock upon the summits of the hills of the oil region is the conglomerate or pebbly rock (the floor of the coal-measures). Beneath this are series of thin bedded sandstones, slates, and shales, alternating with each other with frequent repetitions. The shales, often of an olive green color, are readily recognized as belonging to the Chemung and Portage groups of the New York geologists—a formation which overspreads this portion of the country, extending in New York two-thirds of the way toward Lake Ontario and as far east as Binghamton. It is also continued through Ohio, crossing the Ohio river at Portsmouth, and in this state is known as the Waverley series. Under this is a heavy bed of bituminous shale, 200 or 300 feet thick, called in Ohio the black slate and in New York the Hamilton shales. This group contains an immense amount of carbonaceous matter, and oil is often disseminated through it. Sometimes it runs out in springs and finds an outlet by the occasional fissures in the beds. Dr. J.

OIL WELLS OF PENNSYLVANIA.

S. Newberry, who has given much attention to this subject, is of opinion that this formation contains sufficient carbonaceous material to be the source of the oil, and that the more porous and open shales and sandstones of higher formations are its reservoirs. Such is the geological formation of the Seneca oil region and of the oil springs of Canada West, which are the districts affording this product most remote from the coal-field. But though actual experience alone can determine the extent of the quantities of oil stored up and the period they will last, there is certainly encouragement to be drawn from the never-failing yield of the oil districts of Asia, which for centuries have poured forth without stint their rivers of oil.

The sinking of wells is conducted after the usual method of boring artesian wells. After much uncertain consideration of the chances, a particular spot is selected, more, perhaps, from the hope of its being the right one than from any very practical grounds for the choice; but as the oil flows only in crevices among the strata, the location is frequently determined — other things being equal—by the prospect of reaching the rock at a few feet from the surface, and thereby avoiding the necessity of sinking an open well or driving pipes through unknown obstacles down to the rock. If the bed rock is found within ten or fifteen feet, the boring is begun at once. The derrick being raised. an elm, hickory, hemlock, or other elastic timber is cut down, some 25 or 30 feet in length. The larger end is fixed in a notch of a tree, or heavy post planted in the ground, and another post is set under it at a distance from the butt determined by the elasticity of the timber. The spring of the pole should be sufficient to raise the drill quickly, with its iron connecting rods, weighing often 300 pounds. The rods are suspended from the free end of the pole by a swivel or simple bolt-head, turning freely around. At the commencement of the boring, the rods being very short do not weigh more, including the drill, than 70 or 80 pounds. Two men, therefore, jerk them forcibly down, to increase the momentum of the drill; the spring of the pole immediately raises the drill for the next stroke, while at each blow a man gives it a slight turn so that it may cut a round hole. Several other methods are employed for making the pole spring; by one which is conveniently worked without employing steam or horse power, a sort of double stirrup is suspended from the pole into which two men place each a foot, and pressing the stirrup suddenly down it immediately springs up again with the drill. This is much used, though some wells are sunk by horse-power machinery, and some by steam engines of four or five horse power.

As the well is constantly deepening, while the stroke of the spring-pole (about 30 inches) remains constant, a vertical adjusting screw about 18 inches in length is attached to the end of the spring-pole; the rope is clamped to the lower end or nut of this screw, and then extended to the pulley above. As the well deepens, a slight turn of the screw lowers the rope with the rods attached to it. and thus keeps the drill always free to fall to the bottom with an equal stroke. The work is continued by a constant succession of strokes, to a depth of about fifty feet, successive lengths of iron rods being screwed on as the hole deepens—increasing the weight of the tools to about 300 pounds. The use of any additional rods is then dispensed with, and the upper rod is suspended by a rope attached to the spring-pole, and continued above the pole around a pulley and windlass, used to raise the boring tools when it is necessary to draw them out. They are drawn up in this manner at intervals of an hour or two, in order to sharpen and temper the drill, and to make room for the sand-pump. This is a thin iron tube, a little more than half the diameter of the hole, with a simple valve at the bottom opening upward. It is lowered by a cord to the bottom of the well, then raised up with a jerk, and suffered to drop again by its own weight. This is repeated quickly eight or ten times; a whirl is thus produced in the water below which stirs up the mud and small pieces of broken stone; as the tube drops, the mud and small stones enter the open valve and are retained when the tube is drawn out.

The jarrers are employed to increase the force of the spring-pole when the drill happens to be wedged in the hole by broken pieces of stone or by other obstructions. They are two rectangular links about 18 inches in length, formed of stout bars of iron, and connecting the upper rods with the lower. When the drill descends to the bottom, the upper link as it descends, slips down eight or ten inches in the lower link, and when the pole springs up the upper link has the advantage of moving through this space, and thereby giving a sudden upward jerk to the drill rod. The force of this upward jerk is greatly increased by a heavy rod introduced above the upper link, and which, as it moves up, lends its momentum to the stroke.

The hole is carried down by three men at different rates according to the nature of the strata encountered, varying from a foot or less to six feet in a day. In the hard sandstones of quartz pebbles firmly united together, two or three inches sinking in twelve hours may be all the progress practicable. The material brought up is carefully scanned for any oily appearance indicating the proximity of oil, and the well is watched to observe if any carburetted hydrogen gas escapes from it, which is considered a favorable sign.

The process of drilling in the rock is considered by all concerned in boring for petroleum, a very simple and even welcome operation, especially when contrasted with the uncertainties and apprehensions that surround the driving of pipes. At the outset, the cost of four iron pipes and bands long enough to reach a depth of forty feet, is equal to that of a complete set of boring tools with the rods and ropes sufficient to bore half a dozen wells of 300 feet each in depth. There is often great uncertainty of knowing how deep the pipes will have to be driven, and it is impossible to foresee the various obstacles through which they have to go. When the work has gone down successfully 70 or even 100 feet, the lowest pipe is often suddenly broken or takes an oblique direction. The pipes in the ground are then abandoned, and a new set driven in another place, although in several instances pipes reaching 60 feet in depth have been pulled up by a lever and axle, with chains or rods attached to a lewis wedge driven into the bottom pipe.

The pipes are of cast iron, generally ten or twelve feet long, about five inches bore, and the shell full an inch thick. The lower end of the first pipe is not sharpened, but is driven down blunt as it comes from the mould. The pipes are fastened together in the simplest manner possible, by wrought-iron bands, the ends being turned off, leaving a neck somewhat larger than the interior diameter of the bands, to receive them when expanded by heat.

Through common earth or gravel the pipes are forced down by the ordinary process of pile-driving; but when large stones are encountered, or round boulders as large as a man's head, there is great risk of breaking or turning the pipes. As soon, therefore, as the pipes meet with any great resistance the driving is suspended and the drill is applied to break up the stone or to bore a circular hole in it, which is afterward reamed out as large as the interior diameter of the pipes. The driving is then resumed, and in soft shales the pipes are often forced on, crushing down the sides of the hole, and making their way through to the depth of 12 or 15 inches in the rocky stratum.

The cost of boring a well 200 feet deep is generally estimated at from $1,000 to $1,500. The latter sum includes the cost of all the tools and materials, and also of a small steam engine, a large tank of pine plank, in which the product is collected for the oil and water to separate, and it also allows for such accidents and delays as are common to these operations.

A method now adopted in most of the new wells is called "shooting the well." and is the invention of a Mr. Roberts. When the well has been drilled into the oil producing rock, a can containing from 40 to 60 pounds of nitro-glycerine is carefully lowered to the bottom, and a small iron called a "go devil" is sent down after it, the operators meanwhile taking their flight to a safe distance. As the new wells are from 900 to 1200 feet deep, there is ample time for the escape. A dull thud is heard and a yellow stream of oil spurts up filling the derrick and shooting a hundred feet into the air, to fall against the wind in spray. Mr. Roberts' royalty is $215 including the nitro-glycerine and tools. So there is some "moonlighting," or exploding without paying the royalty.

When the oil is struck it often rises up in the well, sometimes flowing over the top, and in several instances it has burst forth in a jet and played like a fountain, throwing the oil mixed with water high up into the air. Such jets have rarely lasted long, and are usually interrupted by discharges of gas, the elasticity of which drives out with violence the fluids mixed with it, as champagne wine is projected from a bottle on removing the cork. Hundreds of barrels of oil have, however, been wasted at some of the wells for want of means to collect it or stop its flow in its sudden first appearance. At Williams' well, half a mile below Titusville, about 100 barrels of oil were collected the first night the oil was reached, and a large quantity besides was lost. A similar event occurred near Tidioute, the oil rushing up so violently as to knock over the laborer who held the drill and to pass through the derrick and over the trees around. After a time the spouting wells become quiet and the oil settles down, so that it has to be raised by pumping. The pumps are contrived to work at any depth, and by men, or by horse power, or the steam engine. For a time at some of the wells the product has been water alone or water mixed with a little oil; and after pumping several days this has given place to oil with a moderate proportion of water. If the pumping be suspended for a day water accumulates, and it may be several days before this is drawn out and the former yield of oil recovered. The water is generally salt. The flow of oil has rarely if ever been known to fail entirely except by reason of some obstruction in the wells, and in such cases it has usually returned after the hole has been bored out larger or made deeper. The supply is not, however, altogether regular in any of the wells, even after the flow has settled down to a moderate production of 10 or 15 barrels a day. The maximum yield of a well for a considerable time is about 50 barrels a day, and from this the production ranges down to 4 barrels, below which it is considered insufficient to pay expenses.

The oil and water are conducted from the pumps into the large receiving vats, and after the water has subsided the oil is barrelled for the market.

Most of the oil from the Pennsylvania, New York, and Ohio wells is conducted to the sea and lake ports and the refineries by iron pipes laid along the whole route, and under the beds of large rivers. These are with some exceptions the property of the Standard Oil Company, a very rich and powerful corporation which has a controlling influence over the whole Petroleum trade, though they have not hitherto used their power to the injury of the public. It has extensive refineries at Pittsburgh, Cleveland, Buffalo, Philadelphia, Bayonne, N. J., Long Island City and Brooklyn, N. Y., and other intermediate points.

The product of the different wells varies somewhat in quality and value. At Franklin the oil for the most part is heavy, marking as low as 33° Baumé, which corresponds to specific gravity 0.864. Some of the wells furnish oils of 35° or 36°—on Oil Creek the range is from 38° to 46°, at Tidioute 43°. The French Creek oils are heavy. It is not unlikely that the depth of the wells may have some effect upon the quality of the oil, as from very shallow wells those of the lighter varieties must be likely to escape by evaporation, leaving the heavier portions behind. The oils obtained at Mecca, Trumbull county, Ohio, are heavy oils, being thick like goose grease, and marking 26° or 27°, which is equivalent to specific gravity 0.900. At Grafton, Lorain county, Ohio, the oil is even darker and thicker than this, marking about 25° B.

With the exception of some light, clear oils of reddish color, the petroleum is usually of a greenish hue, more or less deep and opaque. It has an offensive smell which is not entirely removed by the ordinary methods of deodorizing practiced in the refineries. The process of purification is similar to that of the coal oil manufacture, as already described. The proportion of light oils separated by distillation varies with the crude petroleum employed. The largest product is about 90 per cent., and from this less amounts are obtained down to about 50 per cent. The properties and uses of these products have already been considered in treating of coal oil.

To complete this account of the petroleum of the United States more particular mention should be made of the extension of the district from northwestern Pennsylvania into New York on one side, and Ohio on the other. In Chautauqua, Cattaraugus, and Allegany counties, N. Y., were many places where the appearance of small quantities of oil upon the surface, and the escape of jets of carburetted hydrogen, indicated the existence of petroleum below; and the names of Olean and another Oil creek, a branch of the Genesee river, suggested the probability of this proving another oil district. As we have elsewhere stated, these suggestions proved correct, and the northern extension of the Bradford district into Allegany county is now one of the most productive oil fields in that region.

In Ohio the oil-producing counties are Noble, Adams, Franklin, Medina, Lorain, Cuyahoga, Trumbull, Mahoning, and some others. Near Cleveland and in the valley of the Cuyahoga oil appears in many places but it has not yet proved of much importance. The vicinity of Mecca, Trumbull county, is the most productive locality. The Canada oil region extends from London, Ontario, toward the St. Clair river.

The California petroleum which created such a furor on its first discovery and examination by Professor Silliman in 1863, and the failure of which caused such heavy losses, proved on further investigation to be of an entirely different class from the Pennsylvania petroleums, containing none of the lighter naphthas, and yielding no paraffine. A burning oil could be produced from this by distillation, which was of much higher density than the Pennsylvania oils, but at a price too high to be profitable.

The fortunes made from these oil wells in Pennsylvania, West Virginia, Ohio, and Canada, in 1860, 1861, and 1862, gave rise to the wildest speculation, and the petroleum fever which set the whole country mad for three or four years, deserves to be classed with the *Morus Multicaulis* speculation of 1836–7, the Washoe Mining Mania of 1857, or the Tulip-mania, and the South Sea Bubble of John Law, in the last century. There was, indeed, a more solid substratum of fact on which to base the petroleum speculation; the oil was found in great quantities and over a wide extent of territory, and there was a large demand for it both at home and abroad; but only a small proportion of the eleven hundred companies which were formed between 1861 and 1865, with their six hundred millions of dollars of nominal capital and actual paid-up capital of perhaps 105 millions, either owned or leased lands or oil wells. The crafty schemers who had raised the commotion and excitement, preferred to make their money by the sale of stock, and if the proposed wells were to be bored, to let their successors undertake their development. The whole community, meantime, had become infatuated; it was difficult to find a man or woman in the city or country who had not taken at least a small venture in what seemed a royal road to fortune, while in reality the chance of ever getting their money back was not one in a thousand. Grave clergymen, eminent lawyers, learned doctors, shrewd bankers, literary and scientific men of the highest character, and with them, merchants, tradesmen, mechanics, farmers, and day-laborers, all purchased shares, and in many instances, invested the little savings reserved for old age or disaster in these very attractive certificates of stock, in oil wells of whose possible productiveness they knew nothing, and of whose locality they had only a vague idea. The process of getting up an oil company was generally something like this: A speculator, often without much capital, would visit the oil regions and procure, at a very low rate, the refusal of the lease of two, three, five, or ten acres of land moderately near the oil lands, but not on them, and return to New York or some of the other eastern cities. Then joining with some other speculators who had more money, the lease would be taken and derricks put up preparatory to boring for a well, the whole expenditure being perhaps $1,000 or $1,500. Then a company would be formed with a capital ranging from $1,200,000 to $15,000,000, officers appointed, the gang of speculators being the officers, with perhaps some innocent whom they had roped in for secretary. The shares were sold at from 20 to 50 per cent. of their par value, the speculators reimbursed, and perhaps $10,000 expended in boring one, two, or three wells, and flaming accounts sent out of the progress made, and the prospect for a grand flowing well of 200 barrels a day. Perhaps oil was struck, then the price ran up, a dividend was made, the stockholders were congratulated on their valuable property, and there was general jubilation; but no second dividend was made, and after four or five years the great majority of the wells "died and made no sign," but a very few were closed up by the benevolent and conscientious speculators, at from half a cent to a cent on the dollar of the amount originally paid for the stock, and these smooth-faced hypocrites divided the money among themselves and were ready for the next opportunity of swindling the public. It is safe to say that innocent stockholders were swindled out of five hundred millions of dollars by the petroleum speculation. It was a lottery in which 999 chances were against them, and the thousandth was not wholly in their favor. Counting up their prospective wealth, as prophesied in the glowing circulars of each new company, men who had never been worth a thousand dollars fancied themselves millionaires, and looked forward to the time when they should set up their carriage, and live in princely style. It was much that the bursting of this bubble did not involve the whole country in financial disaster; but it was really on so sound a basis that these great losses in 1866 and 1867, were borne without any serious panic.

It was worthy of notice, that during the height of this speculative fever, the production of the oil so far from increasing as would naturally have been expected, actually diminished, and it was only after the oil had touched its lowest price that the constantly increasing demand induced a correspondingly large production. For several years the heavy internal revenue tax greatly discouraged production, and the markets were glutted with the commodity so that prices ruled low.

The following table shows the rapid growth of the export trade in petroleum; and reckoning on the assumption, which the most extensive dealers assure is the true one, that from fifty to sixty-five per cent. of the annual production is exported, exhibits also an approximate estimate of the annual product.

Here, then, is an item of production, now exported to the extent of 40 to 60 millions of dollars a year, and sold to the annual amount of 75 millions, which was not, 22 years ago, produced to the extent of $100,000; yet this extraordinary development has only, to a very slight extent, supplanted the trade in other means of illumination and lubrication. The consumption of Olefiant gas has, as we have seen, greatly increased in the same time; whale oil, sperm oil, and lard oil, have largely declined.

STATEMENT

Showing the quantity of CRUDE PETROLEUM produced, and the quantity and value of PETROLEUM PRODUCTS exported from the United States during each of the fiscal years from 1862 to 1881, inclusive.

| Year ended June 30— | PRODUCTION. | EXPORTS. | | | |
|---|---|---|---|---|---|
| | | Mineral, crude, including all natural oils without regard to gravity. | | TOTAL, including Refined Naphtha and other Petroleum products. | |
| | Gallons. | Gallons. | Dollars. | Gallons. | Dollars. |
| 1862 | 21,387,033 | .......... | .......... | 10,387,701 | 1.539,027 |
| 1863 | 60,026.532 | .......... | .......... | 28,250,721 | 5.227.839 |
| 1864 | 104,105,778 | 9.980,654 | 3,864,187 | 23.210 369 | 10.782,689 |
| 1865 | 101,846.010 | 12,293,897 | 6,868,513 | 25.496,849 | 16.563,413 |
| 1866 | 132,959,400 | 16,057.943 | 6,015,921 | 50,987,341 | 24.830,887 |
| 1867 | 150,859,800 | 7.344,248 | 1,864.001 | 70,255,481 | 24,407.642 |
| 1868 | 151.775.778 | 10,029,659 | 1,564,933 | 79,450.888 | 21.810,676 |
| 1869 | 169,955,436 | 13,425.566 | 2,994,404 | 100,636,684 | 31,127,433 |
| 1870 | 185.262.672 | 10,403.314 | 2,237,292 | 113,735,294 | 32,668,900 |
| 1871 | 233,468,550 | 9,859.038 | 1,971,847 | 149,892.691 | 36.894,810 |
| 1872 | 245,384,874 | 13.559.768 | 2,307,111 | 145.171.583 | 34,058,390 |
| 1873 | 304,178,406 | 18.439,407 | 3,010.050 | 187.815,187 | 42.050,756 |
| 1874 | 469,927,122 | 17,776,419 | 2,099,696 | 247,806,483 | 41,245,815 |
| 1875 | 423.520,776 | 14.718,114 | 1.406,018 | 221,955.308 | 30,078,568 |
| 1876 | 370,571.964 | 20,520.397 | 2,220,268 | 243,660.152 | 32 915.786 |
| 1877 | 454.560.582 | 26,819.202 | 3.756,729 | 309,198.914 | 61,789,438 |
| 1878 | 619,007,004 | 26,936.727 | 2 694.018 | 338,841.303 | 46,574,974 |
| 1879 | 710.539,452 | 25,874.488 | 2,180.413 | 378,310.010 | 40.305,249 |
| 1880 | 635,256,393 | 28 297,997 | 1,927.207 | 420,099.599 | 36,218,625 |
| 1881 | 598,998,442 | 39,984,844 | 3,065,464 | 398,005,609 | 40,315,609 |

For several years the fluctuations in the price of crude and refined petroleum were very great and very rapid; but speculation having ceased it has now settled down to a scale of prices which pay a fair but not exorbitant profit on the cost of production. The average prices of 1880 were $7\frac{1}{4}$ cents a gallon for crude, and $9\frac{1}{8}$ a gallon for refined petroleum, and those of 1881 were a shade lower.

# LAND SETTLEMENT—INTERNAL TRADE.

## CHAPTER I.

### WESTERN SETTLEMENT AND TRADE.

PURCHASE OF LOUISIANA—POPULATION AND LAND SALES—AVENUES TO THE VALLEY—CANAL AND RAILROAD EXPENDITURES—LAKE CITIES AND TRADE—RECIPROCITY.

THE original colonies, settled as they were under different grants, circumstances, and powers, had many and conflicting claims to the then comparatively unknown land running back to the Mississippi river, bounded on the north by the chain of lakes, and on the south by the Spanish territories of Florida and Louisiana, when there was a question of union into a confederacy. These various claims were a matter of dispute, which, from being serious, was settled by a mutual cession of the lands to the federal government, in trust, for the common benefit of all the states then existing, or thereafter to become members of the Union. The federal government having thus become owner of the lands, the constitution conferred upon Congress the power "to dispose of and make all needful rules and regulations respecting the territory and other property belonging to the United States." The obvious policy of the government, like that of every other thrifty owner, was at once to attract settlers to these lands, thereby making them serviceable to the whole people as fast as possible. To do so, the lands were to be sold cheap, and as few formalities as possible placed in the way of the settlers. The domain was organized under the control of the Secretary of the Treasury, being administered under him by a commissioner of the land office. The whole domain was divided into districts, for each of which there is a surveyor-general, under whom the territory was subdivided for survey into districts. For each district there was a land office, occupied by a register and a receiver. A plan was prepared of each district by the surveyors, with the utmost care, showing ranges, sections, and townships, with topographic characteristics. Of this plan there were three copies; one is retained at the land office, one by the surveyor, and the third is sent to the general office at Washington, where it serves to regulate all transactions. The land being all surveyed into sections of 640 acres each, was offered for sale by the government at auction, at a *minimum* price of $1.25 per acre. After the land had been on sale two years it may be sold in 160 to 40 acre-lots. The actual occupant of any land offered had the pre-emption to it. The buyer of the land paid the money to the receiver, and took for it a receipt, of which the register sent a duplicate, with a certificate of the sale, to Washington. On the verification of the sale there, the deed of the land, called a "patent," was made out, and sent to the local land office register, who gave it to the purchaser in exchange for the receipt he held, and his title was then complete. In addition to the attractions of low prices and pre-emption rights, long credits were originally given, to enable the settler to pay for the land out of its proceeds. The abuses which sprung up led to a modification of the methods of sale, at different times. Large grants were also made for military purposes, to schools and universities, to states for internal improvements, for seats of government, public buildings, benefit of Indians, salines, swamp lands, and lastly, in aid of canals and railroads—the construction of which aided the settlement of those lands at a distance from large water courses, and therefore from markets. The first land office was opened in 1800, at Chillicothe, Ohio. The first sales of land, however, took place in New York three years before, and in that year a triangle on the lake was sold to Pennsylvania, in order to give her a port on the lake. That port is Erie, and is famous for the building of Perry's fleet there in 1812, in seventy days from the time the wood stood in the forest until the stars and stripes floated to the breeze of the lake from the mast-head. That fleet was fatal to British supremacy on the lakes. Almost all the land sales took place in Ohio, until 1807, when offices were opened in Indiana and Mississippi. In 1809 an office was opened in Alabama, and in 1814 one in Illinois; in 1818 in Missouri, Louisiana, and Michigan. The sales of the lands proceeded with great activity in most of these states up to 1821, particularly after the embargo and war had turned attention from commerce and navigation to agriculture and manufacture. Nearly all the lands of the government were then in the great valley of the Mississippi. This is a vast basin, the sides of which are the eastern slopes of the Rocky Mountains on the west, and the western slopes of the Alleghany Mountains on the east. The chain of great lakes stretches across the northern end of the basin, and the Mississippi river flows through its centre to the Gulf of Mexico, receiving on its eastern side the Illinois, the Ohio with its affluents, and other large rivers which flow generally west from the water-shed of the Alleghanies; and on its western side the Missouri and other large rivers whose waters descend from the eastern slopes of the Rocky Mountains. The only outlets to this vast basin were by the St. Lawrence River (not then navigable, however) north to the ocean, and the Mississippi river south to the gulf. Hardy pioneers did penetrate across the mountains, by a perilous seven weeks' journey, to the Ohio; but once there, intercourse was but limited with the east. The fertile soil was, however, attractive, and the Indian trade profitable. In 1790 the whole population west of the mountains was 108,868 souls, or about 3 per cent of the whole population of the Union. In 1800 that population had increased to nearly 400,000, but the only outlet for their produce was down the Mississippi through the French territory of Louisiana. That circumstance led to great dissatisfaction, and being adroitly handled by the political adventurers of that day, threatened disunion, by dissolving the states east and west—the latter to form a new confederacy with the south-west and Mexico. The remedy was to purchase Louisiana. Fortunately, at the moment Napoleon had relinquished his projects of forming French colonies; also being determined on war with England, he feared the seizure of Louisiana by that power, and determined to sell it to the United States for $14,984,872. This money, in 1803, gave him the sinews of war, and also the hope that the transaction would embroil the United States with his enemy. England did at a later period attempt to take the territories. But the troops who had driven the French out of Spain, embarked from England for the enterprise only to encounter the bloodiest defeat before cotton bags and western rifles. Louisiana was then possessed of a certain amount of population and wealth, which, from being French, by annexation became American. A considerable commerce had grown up. The amount of trade then existing between the eastern and western states may be gathered from the official returns of exports to New Orleans, in the four years before it was annexed, as follows:—

| States. | 1799. | 1800. | 1801. | 1802. |
|---|---|---|---|---|
| Atlantic, | 3,504,092 | 2,035,789 | 1,907,998 | 1,224,710 |
| Western, | —— | —— | 1,124,842 | 1,596,640 |
| Total, | $3,504,092 | 2,035,789 | 3,032,840 | 2,821,350 |

The exports from the Atlantic States were mostly foreign merchandise destined for export up the western rivers. The exports of the western states were the produce sent down for sale. Those exports were the productions of hardy adventurers, whom circumstances had induced to seek their fortunes in the west. As long as the commerce of the country was active, and the sales of the farm products of the Atlantic states profitable, there was less inducement to migrate west than there was after the embargo had wrought a change in that respect, and the means of communication *via* New Orleans had improved. When that port became an American city, and the mighty river to its mouth an American stream, a new attraction was added to the fair lands of the valley, and in 1810 its population had risen to 878,315. The impulse thus given to western settlement was strengthened by the effects of war upon the Atlantic states. The interruption of commerce and stagnation of exports threw out of employment large numbers, who now turned an inquiring gaze beyond the mountains. The capital of the east thrown out of commercial employment by the same circumstances, flowed eagerly into banking, in the hope of deriving large profits from the growing resources of the west; although inevitable disaster followed the erroneous principles on which that banking was conducted, the capital, so lost to stockholders, really promoted agriculture. Instead of confining themselves to advances on produce shipped, the institutions loaned money to make improvements and build houses that the farm profits could not pay for. The result was ruin to those accepting such advances, and insolvency to the banks making them. From 1810 to 1820 six states grew into the Union, while in the fifteen years that followed 1821 none were admitted.

This is an instructive fact, and it indicates that western land speculation, so much overdone at those periods, was a long time in recovering itself. The process of forming new states is mostly a speculative one. The shrewdest operators get possession of the leading "sites" of future cities, and by stimulating and guiding the tide of migration, become wealthy in the rise of prices that the tide creates around them. As the wealthiest names of the eastern cities were men eminent in commercial enterprise, so were those of the western cities the earliest and most extensive land-holders. The political influence which brings the government patronage upon the theatre of such locations, is a part of the machinery to guide the popular movement. When in seasons of speculation, these operators become possessed of considerable tracts, a period of steady and healthy migration is required to distribute possession among settlers and clear the way for a new excitement. Yearly the trade grows by reason of the increasing surplus that the settlers can send to market, and which being sold increases their ability to buy merchandise in return.

There are no data by which to measure the growth of trade in those western states after the admission of Louisiana, up to within forty years, since the accounts were kept only for the foreign trade, and when Louisiana became a state reports were no longer made. The sales of lands, and population of the new states, progressed as follows, however:—

| | 1790 to 1800 | 1800 to 1810 |
|---|---|---|
| Population, increase, | 276,769 | 492,678 |
| Sales of land, acres, | 1,536,152 | 3,008,982 |

| | 1810 to 1820 | Total, 1820 |
|---|---|---|
| Population, increase, | 1,201.248 | 2,079.563 |
| Sales of land, acres, | 8,499,673 | 13,044,807 |

So rapid had been the settlement from 1810 to 1820. The agricultural productions of that region, as a matter of course, followed this rapid settlement of lands, and the exchange of those productions created a large trade of which there is little record. The mines and manufactures sprung up in the several towns, following the wants of the people.

The cession of Louisiana to the United States had produced a dispute in relation to its boundaries between this country and Spain, which then owned Florida. This dispute became very warm in 1819, when it was settled through the mediation of the French minister, by a cession of east and west Florida by Spain to the United States, in consideration of being released from claims for spoliation of American property to the extent of $4,985,599, which the United States government undertook to pay its own citizens. The coast line of the United States thus became complete. There were now large interests west of the Alleghanies, a population of over 2,000,000 souls, occupying fertile land, capable of any development, and great numbers were interested in the rapid appreciation of those lands by settlement. The want of communication was a great obstacle. It required seven weeks to reach the newly settled cities of the west; and when during the war of 1812 it was necessary to send a gun from New York city to Buffalo, it cost six weeks of time and $1,000 in money to do it. There could be litttle trade under such circumstances, and the question was to open communication. A canal from the lakes to tide water on the Hudson was commenced in 1817, and completed in 1825. This Erie canal cost $7,143,789, and soon paid for itself, being the most profitable, as it was the greatest of modern improvements. It opened the door for the great western valley to tide water, and by doing so wrought an immense change in the condition and prospects of all that region. In October, 1823, New York had also completed the Champlain canal, running 63 miles, from Albany to Lake Champlain, at a cost of $1,179,871. Pennsylvania, in 1825, passed an act for the connection of Pittsburg, on the Ohio, with Philadelphia, a distance of 394 miles. This line was not completed until 1834. In 1828, a company was chartered to connect the Ohio with Georgetown, on the Potomac, by the Chesapeake and Ohio canal. These works gave three outlets from the great basin to tide water. While yet they were in process of construction, however, a new power was being developed to supersede them for trade and light freights. In 1828, Massachusetts had 3 miles of railroad; from that nest-egg capital has since hatched 103,000 miles, which cover the country like a network. The opening of the Erie canal was attended with great results, since it placed the produce of western lands cheaply in competition with that of the valley of the Hudson, and of the less productive states of the Atlantic coast. Commerce and manufactures increased, for the reason that agriculture paid less. The supply of labor changed direction, and the increasing numbers in manufacturing employments drew their subsistence from the west. The natural water courses that discharged themselves into the lakes were lined with settlers, and soon Ohio connected the lakes with the Ohio river, by a canal from Cleveland to Cincinnati, and also to Portsmouth. Indiana projected a canal from Toledo, on the lakes, to the Ohio river, cutting the state nearly longitudinally; and Illinois projected one from Chicago to the navigable waters of the Illinois river, thus connecting the lakes with the Mississippi river, nearly opposite the old French town of St. Louis—across the state. These works were not completed, some of them, until ten or fifteen years after they were undertaken. That of Ohio, however, gave a new impulse to trade, not only by Cleveland, on the lakes, but by way of Cincinnati, down the river to New Orleans. These circumstances gave a new impulse to the sales of land and the settlement of the west. The expenditure of money for the construction of canals, and by the federal government for the construction of the great national road running west from the seat of government to the Mississippi, inaugurated the speculative movement in that direction. The bank fever then raged once more in support of the land movement, as it had done in the six years ending with 1820, and with the same results. $200,000,000 of money went from east to west, feeding the flame, until all real capital was nearly consumed, and the speculation ran wild until it burst in 1837. At that time a large quantity of land had passed, under the credit sales of the federal government, into the hands of private speculators, and the western fever lay dormant up to the revival that it experienced in 1846–7, by reason of the famine abroad, and the growing strength of the migration. Attention was then again turned to the lands, and the railroad expenditure began to exert the same influence that canal and bank expenditure had exercised in 1836, and the movement was progressive until the revulsion of 1857.

The natural water courses of the country had been followed by early migrations, and the settlement of the land bordering them had been stimulated by the bank paper speculation of 1810 to 1820. Following the excitement came the construction of the artificial means of navigation, involving an expenditure of some $50,000,000 for canals through new lands opened up by their operation; and these enterprises were again attended with a great bank expansion, that, although ending disastrously, nevertheless had the effect of drawing capital from England and the wealthier Atlantic states to spread it upon the fertile lands of the west. The subsidence of that speculation left the west in comparative quiet, although of general progress, for some years, during which a new and more powerful element of internal development was coming into action. This was the railroad system.

The first railroad of the country was three miles, built in Quincy, Massachusetts, and in operation in 1828, about the time the success of the Manchester railroad in England astonished the world with the new phenomena of locomotion. The example was not slow of imitation in this country; and the Boston and Providence railroad, uniting those cities by forty miles of rail, to connect with the steamboats to New York, was soon in operation. Its success caused other works to be undertaken in New England, and when the Western road was projected, to connect Albany with Boston, it gave the city a direct connection with the Hudson river and the Erie canal. New York projected the Harlem railroad; and from Albany several roads extended west, connecting city after city, until the united lengths of 380 miles made a continuous route to Buffalo—afterward, in 1850, consolidated in the New York Central railroad. Another road—the Erie—to connect New York with Lake Erie at Dunkirk (459 miles), through the lower tier of counties, was commenced in 1842 and completed in 1853. Baltimore projected the connection with Wheeling, on the Ohio, 380 miles, by rail, and Philadelphia connected Pittsburg, on the Ohio, 329 miles, by a line of works which became subsequently a continuous railway.

The New York railroads were not allowed by law to carry freight until 1850, except on payment of the canal tolls. The Canada roads connecting Detroit and Buffalo, and Detroit with Portland and Boston had had the advantage of them, but after 1850 there were five routes from the Atlantic to Chicago. The following was the arrangement in 1850, but has been entirely revolutionized since that time :

| | |
|---|---|
| New York to Chicago, *via* Erie, Lake Shore, and Michigan Southern,.... .. ..................... | 957 |
| New York to Chicago, *via* Central, Canada, and Michigan Central,................................ | 957 |
| Philadelphia to Chicago, *via* Pittsburg and Fort Wayne, ........................................ | 823 |
| Baltimore to Chicago, *via* Ohio Central,............ | 942 |
| Portland to Chicago, *via* Canada and Mich. Central, | 1,133 |

There had been, meanwhile, many western roads built in important localities, which had much favored the export of food in answer to the foreign demand growing out of the famine of 1846-7. In the year 1850, the federal government made a grant of land of about 2,500,000 acres to the state of Illinois, in aid of the construction of the Central railroad, which was to connect Galena, on the Mississippi, and Chicago on the lake, with Cairo, at the junction of the Ohio and Mississippi rivers. The two roads leaving respectively Galena and Chicago, run south, converging until they meet at a point 125 miles from Cairo, and thence proceed together. The state, not being able to do this herself, made over the lands to a company, on condition that they should construct the road. This was commenced in 1852, and finished in 1857, at a cost of $35,000,000. The tract given by the government was in size equal to the whole state of Connecticut, and was a part of 11,000,000 acres that had been over 15 years in the market without finding buyers. The fact that the railroad was to run through them, and spend $25,000,000, and employ 10,000 men in the building of the road, made the lands attractive, and excited speculation. At about the same time the state of Michigan sold the Michigan Central road and the Southern Michigan road to two companies, on the condition of their finishing them, which was done in 1852, establishing a connection between Detroit and Chicago. About the same time the Galena and Chicago railroad was commenced and finished in 1852, making a direct communication from the river at Galena to Chicago, prolonged by the Michigan roads to Detroit, and thence later by the Lake Shore to New York, by the Erie or the Central railroads, or *via* the Canada route to Portland or to Boston. Subsequent connections have been made with the Pennsylvania and the Baltimore roads ; and the western connections of Chicago and Milwaukee have been pushed under a vast expenditure of money. The inauguration of land grants by government, in the case of the Illinois Central, has been followed by grants to other states for the same object, until all the grants amount to 144,000,000 acres ; of this amount 45,150,000 acres had been patented up to July 1, 1880, and nearly 20,000,000 acres since. These grants rapidly developed southern connections, until several routes are now complete between Chicago and New Orleans. Other roads formed a continuous route from Eastport, Maine, to New Orleans, 2,100 miles.

The progress of the construction by miles in each locality has been as follows, in periods of ten years :

| | Eastern. | Middle. | Southern. | Western. | Total Miles. | Cost. |
|---|---|---|---|---|---|---|
| 1828.... | 3 | | | | 3 | $221,101 |
| 1830... | 3 | 38 | 6 | 6 | 43 | 3,501,100 |
| 1840.... | 444 | 1,436 | 461 | 28 | 2,369 | 98,170,001 |
| 1850.... | 2,396 | 2,925 | 1,415 | 1,041 | 7,777 | 291,482,101 |
| 1860.... | 3,824 | 8,176 | 5,552 | 10,718 | 28,270 | 1,009,172,000 |
| 1870... | 4,274 | 10,791 | 11,132 | 22,664 | 48,861 | 2,212,412,719 |
| 1880.... | 6,018 | 15,991 | 14,911 | 56,728 | 93,647 | 5,126,000,000 |

The quantity of railroad iron imported in ten years, to 1850, was 242,449 tons, at a cost of $9,603,587. In the thirty-two years ending with 1881, the quantity imported was 6,135,148 tons, at a cost of $379,786,769. This number of tons suffices for 52,285 miles of road, at 70 lbs. to the yard. From 1855 (which was about the beginning of our production of iron rails in this country) to January 1, 1882, the production of iron and steel rails in this country has been 14,720,282 net tons —more than 2½ times the quantity imported. This fact, never heretofore published, shows that we have not been so entirely dependent on Great Britain for railroad iron as our free-trade friends would have us believe. Our iron and steel rails have been at all times superior in quality to the British, and if we estimate them at the same value, we are certainly not exaggerating their price. This would make the total value of American rails for this period of 27 years about $747,000,000, more than sufficient for 120,000 miles of railway. The money expended upon the roads in the employment of men and in the manufacture of superstructure, rolling stock, etc., of itself caused an immense activity and demand for produce, which, as a matter of course, became scarce and high upon the theatre of such expenditure. The manufacture of superstructure, cars, locomotives, stations, etc., were the means of employing great numbers of men. The railroad iron, of which the manufacture requires the investment of much capital, was alone imported to the extent we have shown. The remaining portions of the railroads were manufactured at home. The first locomotives in the United States were imported from England in the fall of 1829 or spring of 1830. The first Stephenson locomotive ever imported was the "Robert Fulton," in 1831, for the Mohawk and Hudson railroad. The first locomotive built in this country was constructed at the West Point foundry in 1830, for the South Carolina railroad. Since then the improvement in the manufacture of locomotives has been so successful as to admit of the export of thousands of American machines. As the roads were completed, and the hands, numbering at least 200,000 men so employed, were discharged, they naturally turned their attention to the agriculture of the neighborhood where they had been employed, and production thus succeeded to consumption. The effect of the railroad expenditure upon the grain crops is to some extent indicated in the following table of miles of roads in operation in the western states at the periods named, and the population and corn product of those states:—

| 1850. | Miles of Road. | Population. | Bushels of Corn. | Bushels of Wheat. |
|---|---|---|---|---|
| Ohio, ........ | 299 | 1,980,329 | 59,078.695 | 14,487,351 |
| Indiana, .... | 86 | 982,405 | 52,964,363 | 6,214,458 |
| Illinois,...... | 22 | 851,470 | 57,646.984 | 9,414,575 |
| Iowa,.. ..... | | 192,214 | 8,656,799 | 1,530,581 |
| Michigan, ... | 344 | 397,654 | 5,641,420 | 4.925,889 |
| Wisconsin,.. | | 305.391 | 1,988,379 | 4,286,131 |
| Missouri,.... | | 682.044 | 36,214.537 | 2,981,652 |
| | 751 | 5,391,507 | 222,191,177 | 43,840,637 |
| 1870. | | | | |
| Ohio, ........ | 3,724 | 2,675.468 | 65,250.005 | 27,882,159 |
| Indiana,..... | 2,977 | 1,668,169 | 73,000,000 | 27,747,122 |
| Illinois,...... | 4,708 | 2,567,036 | 121,500,000 | 30,128,405 |
| Iowa, ....... | 2,141 | 1,181,359 | 78,500,000 | 29.435,692 |
| Michigan, ... | 1,200 | 1,184.653 | 14,100,000 | 16.265,773 |
| Wisconsin,.. | 1,491 | 1,055 501 | 9,500,000 | 25,606.344 |
| Missouri,.... | 1,827 | 1,725,658 | 80,500.000 | 14.315,926 |
| Total,... .. | 18,068 | 12,051,844 | 415,350,005 | 171,581,421 |
| Increase,... | 17,317 | 6,666,337 | 223,158,828 | 127,540,784 |
| 1880. | | | | |
| Ohio, ........ | 7,406 | 3,198,062 | 111,877,124 | 46,014,869 |
| Indiana, .... | 5,069 | 1,978,301 | 115,482,300 | 47,284,853 |
| Illinois,...... | 9,383 | 3,077,871 | 325,792,481 | 51,110,502 |
| Iowa, ....... | 2,852 | 1,624,615 | 275,024,247 | 31,154,265 |
| Michigan, ... | 3,667 | 1,636,937 | 32,461,452 | 35,532,543 |
| Wisconsin,.. | 5,034 | 1,315,497 | 34,230.579 | 24,884.689 |
| Missouri,.... | 3,876 | 2,168,380 | 202,485.723 | 24.966,627 |
| Total,...... | 37,227 | 14,999,663 | 1,097,353,906 | 262.948.288 |
| Increase,... | 19,159 | 2,947,817 | 652,003,901 | 119,418.288 |

In other words, the population of these seven states had increased in these 30 years (1850–1880) 9,608,156; the railroads 36,476 miles; the corn crop 875,162,729 bushels, and the wheat crop 219,107,651 bushels, the value of this increase being very nearly $500,000,000 at the ruling prices, or the entire cost of all these railroads in less than two years.

But meantime there had grown up in this bountiful West five other states and two territories, now fast filling with railroads, whose grain crops are already rivaling those of the first seven, thirty years ago. They are follows:—

| States and Territories. | Railroads, 1880. | Population, 1880. | Bushels of Corn, 1880. | Bushels of Wheat, 1880. |
|---|---|---|---|---|
| Minnesota,.... | 4,026 | 780,773 | 14.831,741 | 34,601.030 |
| Dakota,........ | 209 | 135,177 | 2.000.864 | 2,830.289 |
| Nebraska,. ... | 2,783 | 452,402 | 65,450,135 | 13,847,007 |
| Kansas, ....... | 1,845 | 996,096 | 105,7[illegible]9.325 | 17,324,141 |
| Oregon,........ | 588 | 174,708 | 126.862 | 7,480,010 |
| Washington, .. | 274 | 75,116 | 39,183 | 1,921,322 |
| California,..... | 2.828 | 864,694 | 1,993,325 | 29,017,707 |
| Total,....... | 12 553 | 3,478,966 | 190,171,435 | 107,021,506 |

In other words, these seven states and territories in 1880, had about two-thirds the population of the first seven in 1850, but with 18 times as many miles of railroad they produced nearly as much corn, and two and a half times as much wheat as the first seven. Had the comparison been made with 1881, the difference would have been as much greater as the preponderance of railroads would have been larger, the wheat crop alone reaching about 150 millions.

We may now observe what had been the actual sales of the public lands by the government in the sixty years ending with 1880, to June 30th, when the fiscal year ends, divided into periods of ten years each; the first, being that of recovery from the speculation that attended the close of the war; the second, embracing the period of bank and canal building excitement; the third, that of recovery from that excitement; the fourth, that of the last great railroad building excitement; the fifth, the Civil War with its depression and reaction; the sixth, the financial depression of

1872, and the great emigration westward which followed it. The quantity sold during the fifty years was, it appears, 160,588,005 acres, besides about 286,000,000 acres granted to agricultural colleges, railroads, homesteads, military service, etc.

ANNUAL SALES OF LAND BY THE FEDERAL GOVERNMENT.

| | Acres. | | Acres. | | Acres. |
|---|---|---|---|---|---|
| 1821, | 822,185 | 1831, | 2,804,745 | 1841, | 1,164,796 |
| 1822, | 763,811 | 1832, | 2,411,952 | 1842, | 1,129,217 |
| 1823, | 638,749 | 1833, | 3,856,227 | 1843, | 1,605,264 |
| 1824, | 723.038 | 1834, | 4,658,218 | 1844, | 1,754.763 |
| 1825, | 871,619 | 1835, | 12,564,478 | 1845, | 1,843,527 |
| 1826, | 839,263 | 1836, | 20,074,870 | 1846, | 2.263,730 |
| 1827, | 905,937 | 1837, | 5,601,103 | 1847, | 2,521,305 |
| 1828, | 946,650 | 1838, | 3,414,907 | 1848, | 1,887.553 |
| 1829, | 1,236,445 | 1839, | 4.976,382 | 1849, | 1,329,902 |
| 1830, | 1,880,019 | 1840, | 2,236,889 | 1850, | 769,364 |
| Total, ... | 9.627,716 | | 62,599,771 | | 16,269,421 |
| Pop.,* ... | 2,233,880 | | 3,707,299 | | 10,454,245 |
| | Acres. | | Acres. | | Acres. |
| 1851, | 1,846,847 | 1861, | | 1871, | 7,118,876 |
| 1852, | 1,553,071 | 1862, | | 1872, | 7,247,904 |
| 1853, | 1,083,495 | 1863, | 9,109,075 (1861–1865) | 1873, | 6,386,415 |
| 1854, | 7,035,735 | 1864, | | 1874, | 4,783,819 |
| 1855, | 15,729,524 | 1865, | | 1875, | 3,791,655 |
| 1856, | 9,227,878 | 1866, | 4,629,313 | 1876, | 4,291.943 |
| 1857, | 4,142.744 | 1867, | 7,041,114 | 1877, | 3,495,030 |
| 1858, | 3.804,908 | 1868, | 6,655,743 | 1878, | 7.2[illegible]9,541 |
| 1859, | 3,961,580 | 1869, | 7,666,152 | 1879, | 8,724,371 |
| 1860, | 4,000,000 | 1870, | 6,663,441 | 1880, | 9,166,918 |
| Total, ... | 52,385,782 | | 41,764,838 | | 62,216,522 |
| Pop.,* ... | 15,081,894 | | 17,217,610 | | 23,498,715 |

* Of land, states and territories.

The total sales of land, from the opening of the land offices to 1880, including grants under the homestead laws, were 244,864,050 acres. There have been also issued land warrants to soldiers, which have taken up large portions of the land. These warrants are for 160 acres, 120 acres, 80 acres, and 40 acres, and have been sold in the markets at $1 per acre for the smaller lots, and about 80cts. the larger warrants, by which means the lands come less to the buyer. In addition to the lands sold, the government has donated acres to schools; 6,851,989 acres to agricultural colleges; 44,971 to deaf and dumb asylums; 12,403,054 to internal improvements; 2,240,184 to individuals; 146,830 to seats of governments; 61,028,430 to military services; 150,756,579 Indian reserves; 17,645,244 private claims; 175,987,069 swamp lands, granted to states; 46,343,325 to railroads, etc.; reserved for individuals, companies, and corporations, 8,955,394 acres; and there remain unsold lands on hand, the trifle of 1,062,231,727 acres.

The population of the land states had increased, it appears, from 2,233,880 in 1830, to 23,498,715 in 1880, during which period of fifty years, 244,864,050 acres of land were sold by the Government. These land sales and population are the groundwork of the national trade, which grows with the surplus produced by the land settlers. Those people at first make few purchases of goods, but increase them as their surplus produce sells and enables them to do so.

The people who seek new lands on which to rear their future homes and fortunes, are, for the most part, not possessed of much capital, and under ordinary circumstances from $1,000 to $5,000 is required for a family to perform a distant journey, locate and prepare land and wait until the crops are grown. Nevertheless, pioneers have ceaselessly pushed forward into the wilderness and battled with nature, with forests, animals and savages, until twenty-one new states and millions of wealth have been added to the Union. The great instruments of this progress, have, under Providence, and in the hands of skillful and determined men, been Indian corn and wheat. These grains have been the poor man's capital, enabling him to conquer the wilderness. It needed on his locating his future home but to drop the seed into the fertile soil, and while he busied himself with his new dwelling, a sure crop grew up, which in a few months became food for his family and his animals. The husks furnish his bed and the cobs his fuel. He is thus by the gift of nature furnished with capital for the coming year, until his other crops and young animals have grown. Indian corn has thus given the pioneer a hold upon the land and made his footing firm where otherwise he might have been compelled to succumb to hardships. With every such remove on to new land the circle of trade has increased. A few months only suffice for the settler to furnish a surplus of production in return for comforts that he desires. For this reason chiefly corn figures so largely in the agriculture of the west. The prolific soil throws out quantities far beyond the wants of the planter, and in a region where all are planters, the supply becomes superabundant and must find distant markets only at rates so low as to leave little to the grower. Two local demands are created for it. The most important of them is to feed hogs, and pork becomes a leading staple export; the other is for distillation, and whiskey is largely exported. The quantity of corn required to make a certain quantity of pork becomes accurately known, and the price of meat rises and falls with that of the grain, as does whiskey also. Thus out of the great staple grain Indian-corn come directly the three great articles of export, corn, pork and its manufactures, and whiskey. Wheat, on the other hand, is of late years a grain commanding more promptly a cash return for labor, and hence in the newest states and territories, many of which are not so well adapted to corn, it is the favorite pioneer crop. Lumber in most new countries is also an important export. As the settlements progress, beef, wool, wheat and other grains, soon follow, and trade increases. While Indian corn has been largely the instrument of settlement at the West, the nature of the country and the fertility of machine inventions have been no less necessary in securing a surplus for sale. If the corn grows readily it could not under the old system be so readily harvested in a region where land belonged to every man, and every man's labor could be applied only to his own service. At the same time no man's labor more than suffices for the wants of his own family. Here machinery steps in, and favored by the level nature of the soil, operates to a charm. A man who could with the scythe cut from one to one and a half acres of grass per day, may ride round a field and cut ten acres in a day without fatigue. Instead of a gang to rake and turn and cock, his horse and himself may with a patent rake perform all that labor and more effectually when driven by a shower of rain, than any gang. His grain is cut by the same means and light labor as his grass. It is threshed out by a similar process; his corn is husked and shelled by machines; and when drawn to the railroad depots it is elevated into vast receptacles to be transported rapidly and at small cost to the best market. All these machine aids enable the man whose own labor would scarcely supply the demands of his family to turn out a vast surplus. This surplus seeks the river and lake cities by rail, canal, and steam, to be transported to the Atlantic markets for consumption or export, or may now leave Chicago and Milwaukee on the lakes, or St. Louis and Cincinnati on the rivers for Liverpool direct without breaking bulk. The table of land sales above gives a very good indication of the accumulating force behind the forwarding cities to push forward the trade. As every bushel of grain they receive requires an equivalent from them in goods, each grows under the double demand. Their combined growth is the basis of lake and river trade, distributing the produce for consumption, and bearing back goods in return, while the foreign commerce of the country grows with the aggregate surplus to be exported and the consequent increase of the merchandise received in exchange. Having glanced at the settlement of the western lands, it becomes no matter of surprise that the cities which were the focus at which such large quantities of surplus products concentrated grew rapidly, and grew in proportion to the rapidity of settlement and the perfection of the means of internal communication. It may be worth while to sketch the leading ones, first those of the lakes.

Buffalo, on Lake Erie, was laid out originally in 1804, but was of small importance until in 1825 by the opening of the Erie canal, it became the gateway from the great valley to the Atlantic states. Its population was then 3,000. As the "great valley" at that time had, however, but little to spare, the importance of Buffalo was to swell with the growth of the west, which was rapid indeed. In 1832, thirty-one years from its settlement, Buffalo became a city with 8,653 inhabitants. In the thirty-eight years that have since elapsed the population has risen to 155,159. In 1825, the tonnage belonging to the port was 200 tons. It has grown to 99,544 tons, valued at $54,000,000, besides 1,250 canal boats. The entries and departures of vessels at Buffalo in 1880 were 10,308, aggregating 5,995,747 tons. The experts and imports of Buffalo by canal in 1880 were $92,231,558. The railroads carried larger amounts of grain than the canals, and almost all the live stock, which amounted to 786,386 cattle, 2,251,815 hogs, 1,033,200 sheep, and 20,768 horses. The lake commerce was also larger.

The opening of Dunkirk to New York over the Erie road created a rival to Buffalo, and the Welland canal round the falls permitted vessels to go to Oswego, where they take either canal or railroad on a shorter route to New York, also rivaling Buffalo. It is obvious that a few miles longer trip adds little to the cost of a loaded ship, and by reducing the canal and railroad transportation the cost is diminished. Hence Oswego has some advantage over Buffalo.

The imports into Buffalo by lake and railroad, showing the relative and aggregate values, indicate the gain of "rails" over "sails." They were, for a number of years, as follows:

| | Lake. | Railroad. | Total. |
|---|---|---|---|
| 1850, | $22,525,781 | | $22,525,781 |
| 1851, | | | |
| 1852, | | | |
| 1853, | 36,881,230 | $2,234,273 | 39,115,503 |
| 1854, | 42,030,931 | 6,397,923 | 48,428,854 |
| 1855, | 50,346,819 | 10,968,384 | 61,313,203 |
| 1856, | 42,684,079 | 16,422,505 | 59,106,584 |
| 1857, | 36,913,166 | 15,020,580 | 51,933,746 |
| 1870, | 87,419,381 | 95,183,721 | 182,602,102 |

The gain continued, though the comparative increase was not large in the decade from 1870 to 1880, but as the reports are in quantities and not in values, it is impossible to make the comparison with previous years.

Oswego, settled in 1797, on Lake Ontario, has been mostly the creation of the Oswego canal and of the railroad communication since established, which makes its position on the lake with reference to the Canada and lake trade very desirable. The canal was completed in 1828, the Welland canal in 1830, and the Oswego and Syracuse railroad in 1848, when Oswego, having 10,305 inhabitants, was incorporated as a city. The modification of the English colonial trade system, and the admission by the United States of goods in bond under the warehouse system, laid the foundation for a great development of the business of Oswego on the occasion of the famine of 1847, when the trade of the place took a sudden start, which it has since maintained. The Welland canal, connecting Lakes Erie and Ontario, gave Oswego a line of communication with the west, by which freight coming thence to the east, would have *via* Oswego less canal navigation than by other routes. In May, 1857, the Welland railway, running along the banks of the canal, was projected, and completed in 1860, thus giving a communication all the year round. By these means Oswego draws its supplies from every western state. The imports from foreign countries in 1881 were $5,652,705, and the exports $1,177,013; the tonnage of the port amounted in 1880 to 22,219 tons exclusive of 772 canal-boats, measuring 84,411 tons. Pop. in 1880, 21,116.

Cleveland.—The place was settled by one family in 1799, but its population did not increase beyond 500 in 1825, when the Erie canal was opened. Its greatest impulse was derived from the construction of the Ohio canal, connecting it with Cincinnati; the Pennsylvania and Ohio canal, connecting it with Pittsburg, and the Welland canal in Canada, connecting Lake Erie with Lake Ontario. Since that event a considerable Canadian trade has sprung up in Cleveland. The canals of Ohio brought down the increasing quantities of produce that were then exported in exchange for the merchandise that was delivered by lake for the consumption of the interior. In 1832 there were 26 sail vessels and one steamer belonging to Cleveland; there were in 1880 55 steamers and 120 sail vessels, with an aggregate tonnage of 67,597 tons owned there. The multiplication of railroads has, however, added since 1855 more to the city business than either canals or tonnage. There are twelve roads running into Cleveland, of an aggregate length of over 2,000 miles, and their annual receipts are more than 50 million dollars. These, crossing Ohio in every direction, connect the city with Toledo, Columbus, Pittsburg, and New York. With these advantages, and an active commerce with Canada, a large foreign trade sprung up. In 1881 the imports and exports were as follows:

| | Vessels. | Tons. | Coastwise. | Foreign. | Total. |
|---|---|---|---|---|---|
| Exports, | 3,652 | 1,579,278 | $76,187,390 | $652.816 | $76,782,593 |
| Imports, | 3,585 | 1,561,010 | 108,249,861 | 155,543 | 108,819,845 |

The trade between Cleveland and Lake Superior has also become important within fifteen years, in which time it has risen to more than 1,150,000 tons, mostly in iron and copper ore. In 1856–1861, Cleveland had, in common with several of the other lake ports, a growing and flourishing direct trade with Europe through the Welland canal. Ten vessels, of 300 or 400 tons, ran regularly for some time between Cleveland and Liverpool. Owing to the war and the unprofitableness of this trade, it has now very much declined, but the city has become largely interested in manufactures, having over $14,000,000 capital invested in them, with an annual product of nearly $36,000,000. The refining of petroleum oils is carried on to a great extent here, the city being the headquarters of the Standard Oil Company. The manufacture of sewing machines is also very extensive here. The coal trade of Cleveland has become large for the supply of the steamers and factories on and around the lakes; the supply is about 917,000 tons per annum. Population in 1880, 160,142.

Detroit.—This is the oldest of the western cities, having been early occupied by the French, but its progress, like the others, was slow until the opening of the Erie canal. Its first permanent settlement was made in 1701, but in 1820 it had a population of only 1,442. Its progress since has been largely due to the Michigan system of railroads which centre there and to its facilities for certain branches of manufactures, particularly iron, copper, lumber, glucose, and chemicals. The product of these in 1880 was $25,455,773. The railroads running into the city from all directions are over 3,000 miles in length. The annual shipment of cereals from Detroit exceeds 10,400,000 bushels. It is also a great wool market. Its population in 1880 was 116,342.

Chicago is the most remarkable of the western cities for its growth. Its location was good, at the southern extremity of the lake, but though it had a fine harbor, sufficient for any lake trade, it could not thrive until the back country supplied it with produce to sell, and required of it merchandise in exchange. Though occupied as a garrison in 1812, and a trading port in 1823, it had less than fifty inhabitants till 1832. The Illinois and Michigan canal, connecting the lake with the navigable waters of the Illinois, was commenced in 1836, 100 miles in length. In aid of this work the federal government donated alternate six-mile sections of the public lands. The state had also projected a large system of railroad improvements on a scale far beyond its means, and it failed in 1840. Subsequently the means was raised to complete the canal, which was effected in 1850. The yearly arrivals and clearances of vessels in the port were 8,673,638 tons in 1880. In 1880 there were 19 trunk and about 50 other railroads, with an aggregate mileage of over 20,000 miles, radiating from Chicago as their common centre. The expenditure of about $1,500,000 in the construction of these roads, and the great development of the country through which they pass, has made the growth of Chicago rapid beyond all precedent. The vast grain, live stock, lumber and mining products poured into it have made it a great commercial city, even beyond what its population would indicate. Over the 20,000 miles of railroad, much of it traversing the finest grain country in the world, the cereals have come in such quantities as to make Chicago the first primary grain port in the world, shipping as it does about 136 million bushels of grain per annum eastward, importing and exporting to the amount of $250,000,000. Chicago is only six or eight feet above the level of the lake, but the harbor has a depth of thirteen feet of water, and will always be ample for the commerce of the lakes. The number of vessels arriving here in 1880 was 12,806. with a tonnage of 4,334,393 tons. The clearances were 12,913 vessels, 4,339,245 tons. The Canadian rules in relation to navigation enable Chicago vessels to clear direct for Europe, and there are a number in the trade by which produce and goods are shipped direct to Europe. The total value of produce exported direct in 1870 was $4,189,255, and imports $860,108. But this is the merest trifle in comparison with its immense shipments of breadstuffs, provisions, lumber, and machinery in all directions east, west, and south. The shipments of breadstuffs, provisions, etc., are given in the following tables:—

SHIPMENTS OF FLOUR (REDUCED TO WHEAT) AND WHEAT AND OTHER GRAINS

From Chicago for specified years from 1838 to 1880.

| | Bushels. | | Bushels. | | Bushels. |
|---|---|---|---|---|---|
| 1838, | 78 | 1851, | 4.646,291 | 1870, | 54,745,903 |
| 1839, | 3,678 | 1853, | 6,412,181 | 1871, | 71,800,739 |
| 1840, | 10,000 | 1854, | 12,932.320 | 1872, | 83,361,224 |
| 1841, | 40,000 | 1855, | 16,633,700 | 1875. | 72,369,194 |
| 1842, | 586,907 | 1856, | 21,583,221 | 1876, | 87,241,206 |
| 1843, | 688.907 | 1860, | 31,108,759 | 1877. | 90,706,076 |
| 1844, | 923,494 | 1861, | 50.481,862 | 1878. | 118.675 469 |
| 1845, | 1,024,620 | 1862, | 56.477,110 | 1879, | 125,528.879 |
| 1846, | 1,599,819 | 1866, | 65,486.323 | 1880, | 154,377,115 |
| 1847, | 2,243,201 | 1868, | 63,688.358 | | |
| 1848, | 3,001,740 | 1869, | 56,759,515 | | |

The following are the shipments of pork, provision, and cut meats, lard, beef. wool, and lumber, specified from 1861–1880:—

| Year. | Pork. Barrels. | Provisions and Cut Meats. Pounds. | Lard. Pounds. | Beef. Barrels. | Wool. Pounds. | Lumber. Feet. |
|---|---|---|---|---|---|---|
| 1861 | 65,196 | 59,748,388 | 16,400,822 | 50,154 | 1,360,617 | 189,379,445 |
| 1862 | 193,920 | 71,944,010 | 54,505,123 | 151.631 | 2,101,521 | 189,277.079 |
| 1863 | 449,152 | 95,300,815 | 58,030,728 | 137,302 | 3,435,956 | 221,709,330 |
| 1865 | 284,734 | 55,026,609 | 28,487,407 | 103,604 | 9.923,069 | 385,353,678 |
| 1866 | 257,470 | 73,011,584 | 26,758,368 | 67,762 | 12,391,933 | 422,313,266 |
| 1870 | 165,885 | 112,433,168 | 43,292,249 | 65,369 | 15,826.536 | 583,490,634 |
| 1872 | 208,664 | 238,727,684 | 86,040,785 | 39,911 | 27,720,089 | *417,980,507 |
| 1874 | 231,350 | 262,932.000 | 82,210,000 | 72,562 | ......... | *580,694,000 |
| 1875 | 313,713 | 362,142,000 | 115,616,000 | 60,464 | ........ | *628,485,000 |
| 1876 | 315,448 | 465,404,000 | 137,072,000 | 72,004 | ......... | *450,092.000 |
| 1878 | 193,236 | 818,461,401 | 201,376,033 | 58,712 | 42,053,907 | *460,450,000 |
| 1879 | 207.912 | 940,084,542 | 209,780,410 | 98,997 | 45.582,352 | *480,796,000 |
| 1880 | 205,004 | 1,109,143,569 | 226,751,428 | 106,468 | 37,109,339 | *650,140,000 |

* During all these years more than one-half of the receipts of lumber were consumed in the city or were shipped westward as planed lumber.

MILWAUKEE is one of the chief cities of the western shore of Lake Michigan. It was settled in 1834, and up to 1840 could boast of but 1,700 inhabitants. The population had grown to nearly 20,000 in 1850, to 71,499 in 1870, and to 115,578 in 1880. The growth has been most rapid under the settlement of the country west of it, by means of the large expenditures there made in the last fourteen years for railroads. These in the state (Wisconsin) had in 1880 an aggregate length of 5,034 miles, and have been constructed mostly in the last twenty-five years at an expense of $150,000,000. The expenditure of this large sum of money, in addition to that laid out by speculators and emigrants, imparted an impulse to the prosperity of the city which is reflected in its population and valuation. The circle of fertile country poured into the city products which were exported from it to the value of $35,890,288 in 1870, and in return $59,180,000 worth of goods were imported. The manufactured products of the city in 1880 were, according to the census, $33,738,977. The quantity of grain shipped from Milwaukee in 1880 was 29,691,524 bushels, and from other lake ports of Wisconsin 1,561,881 bushels. The grain movement, which is the basis of the city's commerce, indicates the ratio of its growth, and is as follows:

| | Bushels. | | Bushels. | | Bushels. |
|---|---|---|---|---|---|
| 1851, | 576.580 | 1858, | 6,155,507 | 1876, | 31,678,433 |
| 1852, | 1,029.379 | 1859, | 6,438,038 | 1877, | 31,867.348 |
| 1853, | 1,476,998 | 1862, | 18,730,000 | 1878. | 34.088.546 |
| 1854, | 2,534.617 | 1866, | 16,700.000 | 1879, | 34,344.542 |
| 1855, | 3,758,965 | 1870, | 23,100,000 | 1880, | 29,691,524 |
| 1856, | 3,720,103 | 1874, | 35,170,580 | | |
| 1857, | 3,727,468 | 1875, | 34,770,315 | | |

Milwaukee exports other articles in large amounts; e. g. Wool to the extent of 6,000,000 pounds; iron, product about $10,000,000, nearly half exported; butter, about 9,000,000 pounds; cheese about half that amount; Wisconsin tobacco, over 10,000,000 pounds; lager beer of the value of $5,000,000; hops from 12,000 to 15,000 bales.

We may recapitulate these lake cities in the following table, showing the date of settlement, of incorporation, and population at that date, with the population and valuation from 1850 to 1880:—

| | Settled. | Incorporated. | Pop. | Populat'n in 1850. | Total Valuation in 1850. |
|---|---|---|---|---|---|
| Buffalo,...... | 1801 | 1832 | 8,653 | 49,764 | $18.427,000 |
| Oswego, ..... | 1820 | 1848 | 10.305 | 12,205 | 9,107,202 |
| Cleveland,... | 1799 | 1836 | 4 000 | 17,034 | 12,102,101 |
| Detroit, ...... | 1682 | 1802 | 700 | 21,057 | 10.741,657 |
| Chicago, ..... | 1833 | 1835 | 800 | 29,963 | 31,205,000 |
| Milwaukee,... | 1852 | 1840 | 9,655 | 31,077 | 18,421,000 |
| Total,................. | | | 34,113 | 161,100 | $100,003,960 |

| | Populat'n in 1860. | Total Valuation in 1860. | Populat'n in 1870. | Total Valuation in 1873. | Population in 1880. | Valuation in 1880. | Annual Manufacturing Products. 1880. |
|---|---|---|---|---|---|---|---|
| Buffalo, ............ | 117,715 | $112,920,150 | 117,714 | $110,100,000 | 155,134 | $92,256,315 | $38,820,560 |
| Oswego, ........... | 20,910 | 19.425,800 | 20.910 | 18.600,000 | 21,117 | 21,823,500 | . ......... |
| Cleveland, ......... | 93,918 | 92,325.000 | 92,829 | 65.000.000 | 160.146 | 73.647.194 | 35.803,592 |
| Detroit,............ | 79,588 | 79,809,951 | 79,577 | 86,743.947 | 116.340 | 97,500,000 | 25,455,773 |
| Chicago. ........... | 298,983 | 358,783,515 | 298,977 | 275.986,550 | 503,185 | 358,750,000 | 253,405,695 |
| Milwaukee, ........ | 71,499 | 57,805,772 | 71,440 | 48,559,817 | 115,588 | 67,325,000 | 33,738,977 |
| Total,.......... | 682,613 | $712,370,138 | 681,447 | $604,989,314 | 1,071,509 | $711,302,009 | $387,224,597 |

Thus these prominent cities have grown up, so to speak, in 50 years, as points where farm produce is received from the country for sale, and where goods are furnished in exchange. The whole value of the lake trade has been estimated at $1,200,000,000 per annum, and the transaction of this business has, it appears, created six cities, with a population of 1,071,536 and a taxable valuation of $711,302,009. The manufactures have gradually increased in those cities in order to produce a local supply instead of importing, and new inventions in sewing and other machines have promoted that change, as machinery aided the development of surplus produce. The aggregate trade poured upon the lakes from all these sources has been increasingly large.

Great fluctuations follow the course of western business. In 1857 there was a heavy decline under the influence of the panic of that year. In 1858, the speculative consumption of the interior having ceased, the quantities that sought market were less than in 1856. In 1873 there was a falling off of trade from the panic, and the pressure produced by the losses of the great fire in Chicago in 1871; but the great development of the West caused this to be felt less sensibly there than in the Eastern cities, and these lake cities are now in the full tide of prosperity.

The rapid settlement of the States of Ohio, Indiana, Illinois, Michigan, Wisconsin, and later of Minnesota, led the Canadians to make very strenuous efforts to attract a large portion of the transportation of products to their magnificent waterway, the St. Lawrence river. It was necessary, however, that there should be considerable expenditure to facilitate this transportation. There were rapids on the St. Lawrence which were at all times troublesome to heavily freighted vessels, and at some times dangerous; there was a difference of level between Lake Erie and Lake Ontario of 331 feet, which could only be overcome by a canal with locks, and these locks must be sufficiently long, wide, and deep to admit of the passage of vessels of from 700 to 1400 tons burthen, and of corresponding length, width, and draught. The canals for these purposes, as well as one connecting Montreal with Lake Champlain, were carried on to sufficient completeness to answer the first demands as early as 1846. They have since been greatly enlarged at several times, and the Welland canal to be opened anew the present season, (1882,) can pass through its locks vessels of 1,360 tons; and the rapids of the St. Lawrence are now passed in safety by lateral canals. The Welland Canal has been of great service to the commerce of Oswego, and the canal from Montreal to Lake Champlain in connection with the enlarged Champlain Canal in New York, connecting with the Hudson River, has brought vast amounts of grain and provision to New York City with more celerity and at lower prices than any other route. The lower St. Lawrence and its broad gulf are not safe for vessels of moderate tonnage and of no great sea worthiness, as its upper waters, and hence there was a strong tendency to leave the river at Montreal and take a straight line for New York, the transportation being much less than that by a sea voyage.

But the canals had hardly begun to develop their capacity for this vast carrying trade before the Canadians found it neces sary to commence extensive railway lines to obtain their share of the travel and transportation north of the lakes. They had the advantage of shorter lines than were possible in the northern United States, but they had the disadvantage of a colder climate and a greater liability to obstructions in the winter. Their first constructed line was the Grand Trunk from Montreal to Toronto, begun in 1852, and in 1853 amalgamated with the Main Trunk line, which connected Montreal with Portland, Me., and crossed the St. Lawrence at Montreal over the Victoria bridge, while on the west it was extended to Sarnia and Detroit, Michigan. The Great Western Railway extending from Toronto, Hamilton, London, and Windsor opposite Detroit, and several branches extending to Collingwood, Simcoe, Goderich, etc., was another important line, and the Canada Southern from Buffalo to Detroit, along the northern shore of Lake Erie, formed a connecting link in another Trunk line to the west. These roads have conducted a large and profitable business to the west, and have carried their fair share of passengers and freight. But the Canadians were not yet satisfied; they were connected by these roads and other branch, and affiliated roads, with Lake Huron and the chain of northwestern lakes (by steamers) on the west, and with Toronto, Ottawa, Montreal, Quebec, Portland, and Boston on the east; and in connection with United States railroad companies they had extended their lines through New Brunswick and Nova Scotia to St. John, Shediac, Pictou, and Halifax, and as far as Metis on the S. Quebec peninsula.

But they had seen the completion of the Union and Central Pacific in 1869, and remembering their colony of British Columbia on the Pacific, they were filled with an intense desire to push a transcontinental road across their territory and thus forestall the Northern Pacific, which was already begun. The struggle for this road has been persistent for the last twelve or fifteen years, and large sums have been expended on it. It is now to be completed, but by an American company, and the Northern Pacific will be also completed at about the same time. The Canadian Pacific will traverse Manitoba, the northwest territories, following Fraser river, British Columbia, to Fort Fraser and thence descending to Vancouver Island in latitude 50°. The road is completed from Keewatin to Battleford.

## CHAPTER II.

### RIVER CITIES—ATLANTIC CITIES.

The development given to the lake cities by the canal and railroad construction, was participated in to as great an extent by the river cities, the course of whose trade flowed downward toward New Orleans as an outlet.

Pittsburgh is situated at the point where the junction of the Monongahela and Alleghany forms the Ohio river, which thence flows to the Gulf of Mexico. The origin of the place dates from its occupation by the French as a post, and its growth is due to its commanding position. It is 301 miles east by north from Philadelphia, and is 130 miles from Lake Erie. The traveler descends the river 450 miles to Cincinnati; 583 to Louisville, Kentucky; 977 to Cairo, where the Ohio pours into the Mississippi; 1,157 to St. Louis, and 2,004 miles to New Orleans. That vast valley collects in its course the produce coming right and left by streams, canals, and railroads, to deliver it at New Orleans, whence ascend the merchandise, tropical products, and materials of manufacture, to be distributed at the commercial and manufacturing ports. The position of Pittsburgh was the most important, commercially, until the opening of the Erie canal. Its resources were highly favorable to ship-building, and it supplied the first boats that descended the Ohio. The commerce and ship building prospered largely during the war of 1812, but after the peace it declined. Since that period manufactures have taken the place of commerce, and it ranks next to Philadelphia as a manufacturing town. The population in 1800 was 1,565, and in 1816 it was incorporated as a city with about 6,150 inhabitants. The population of Pittsburg in 1880 was 156,389; while Alleghany City, across the river, had 78,682, and other suburbs really forming part of the city, about 35,000 more, making a total of about 270,000. The progress of the city has been as follows:

| | Population. | Value of manufactures. |
|---|---|---|
| 1816, | 6,182 | $1,896,366 |
| 1836, | 15,481 | 15,575,440 |
| 1850, | 46,601 | 55,287,000 |
| 1860, | 49,220 | 70,000,000 |
| 1870, | 86,235 | 111,881,000 |
| 1880, | 156,389 | 138,163,000 |

Cincinnati was located at the mouth of the Licking river in 1788, in the centre of an area which commanded the commerce of the Miami, the Wabash, the Scioto, the Muskingum, and the Kanawha rivers. These streams delivered large quantities of produce to foster the trade of Cincinnati, which grew with great rapidity, corresponding mostly with New Orleans, to which its merchants sent the produce, and made purchases of goods in the eastern states, which came up the river from New Orleans by a long voyage, charged with expenses for freight, insurance, etc. The exchanges ran on New Orleans against the produce sent down, and these credits were the means of payments for goods. The opening of the Ohio canal to the lakes, to correspond with the Erie canal to tide-water, gave a new outlet for produce of the northern part of Ohio by way of Cleveland, and also a better channel for the receipt of goods. The net-work of railroads has still further multiplied the means of communication. Portland, Boston, New

York, Philadelphia, and Baltimore, are almost equidistant from Cincinnati, which by the same means has its markets extended in a broader circle west. The progress of the city has been as follows:—

| | Population. | Imports. | Manufactures. | Exports. |
|---|---|---|---|---|
| 1800, | 750 | | | |
| 1810, | 2,540 | | | |
| 1820, | 9,644 | $1,619,030 | $1,059,459 | $1,334,080 |
| 1830, | 24,831 | 2,528,590 | 1,850,000 | 1,063,560 |
| 1836, | 31,207 | 8,270,000 | 12,388,200 | 8,101,000 |
| 1840, | 46,338 | 16,972,000 | 17,780,033 | 15,480,000 |
| 1850, | 115,435 | 41,256,199 | 54,550,134 | 33,234,896 |
| 1860, | 161,044 | 96,213,274 | 112,254,000 | 66,007,707 |
| 1870, | 218,900 | 312,978,665 | 127,459,021 | 193,517,690 |
| 1880, | 255,139 | 256,137,902 | 148,957,280 | 253;827,267 |

It should be remembered that the values of 1870 were currency values, and inflated from 33⅓ to 50 per cent.; those of 1880 are specie values, and at a time when prices were at their lowest point. The 658 millions of values of 1880 represent in the currency of 1870, and at the prices then ruling, more than 950 millions, against about 634 millions in 1870. The manufacturing products, in 1881, aggregated over 175 millions. The Cincinnati Southern railroad, completed in 1879, and now extending to Chattanooga, Tenn., with close connections and liberal arrangements with all the leading southern roads, and a permanent connection made with the Texas and Southern Pacific, has already become, and will be henceforth to a much greater extent, a potent factor in the growth of Cincinnati, which had almost ceased after the war, under the intense competition of its rivals. It opens to it a wide southern trade, and gives it the advantage of its immense capital, and shorter lines of distribution.

Louisville, Kentucky, was a port early in 1781, and it made little progress as a city. Its population grew but to 600 in 1800, and was only 4,012 in 1820. The difficulties of navigation were a drawback upon its commerce, until the Portland canal, two miles long, which had been authorized in 1804, around the falls of the Ohio, was opened in 1830. The cost of the work, $600,000, was paid, one-third by the United States, and the balance mostly in eastern cities interested in getting goods up the river. A bridge over the Ohio was built in 1836, at a cost of $250,000. The city was incorporated in 1828, and its population was then 10,336. In 1836 the population was 19,967, and the annual amount of business transacted was $29,004,202. In 1840 the population was 21,210, and in 1850 it had again doubled, reaching 43,194.

St. Louis was occupied as a French trading post in 1763, and the town was laid out in the following year, with the name of St. Louis, in honor of that Louis XV. who had so little claim to saintship. The first impulse to its growth was, however, the annexation of Louisiana to the United States, when emigrants poured into the new country, bringing with them a spirit of enterprise which soon produced its effect upon St. Louis, the commerce of which struggled against the difficulties inherent in barge and keel boat navigation. In 1817 the General Pike, the first steamboat, arrived at St. Louis. That event marked a new era, and in 1822, the population being 4,598, the city was incorporated. It was not until the settlement of the northwestern states, under the influence of the canals and railroads, that the prosperity of St. Louis became marked. In 1836 the sales of merchandise in St. Louis were given at $6,335,000; in 1858 the local insurance was $31,800,232. The population of the city, which had been 63,491 in 1848, rose to 350,518 in 1880, and the city valuation was $163.813.920. The settlements of the upper Mississippi, east and west, pour naturally an increasing trade into the city, and its railroad connections are now complete in four lines to the Pacific. We may recapitulate the leading river cities as follows:—

| | Settled. Date. | Incorp. | | 1840. | 1850. | | 1860. | | 1870. | | 1880. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Date. | Pop. | Pop. | Pop. | Valuation. | Pop. | Valuation. | Pop. | Valuation. | Pop. | Valuation. |
| Pittsburg, ..... | 1781 | 1816 | 6,150 | 21.115 | 46 601 | $27,960.600 | 49.220 | $46,866.600 | 86,076 | $98,275,481 | 156.389 | $113.865,320 |
| Cincinnati, .. . | 1788 | 1802 | 890 | 46 338 | 115,436 | 55,670.631 | 161.044 | 91,861,978 | 216.239 | 175,084,296 | 255,139 | 207.324,069 |
| Louisville, .... | 1773 | 1828 | 10,336 | 21,210 | 43,194 | 17,277,600 | 69.740 | 30.042.800 | 100.753 | 71,000,000 | 123,758 | 65.809.000 |
| St. Louis, ...... | 1764 | 1822 | 4,598 | 16,469 | 77,860 | 38,921,201 | 151.780 | 78,463,375 | 310,864 | 147,969,660 | 650,518 | 163,813.920 |
| Total,........ | .... | .... | 21,974 | 105,221 | 283,091 | $139,830,032 | 431.784 | $247.234,753 | 713,932 | $492,329.437 | 885,804 | $550.812.309 |

The numbers and wealth of the river cities have increased in a ratio, nearly as large as the lake cities. They divide with the latter the trade of country lying between the lakes and the Ohio river, drawing produce and shipping merchandise, while they have also a strong hold upon southern trade. The business of all those cities, as well lake as river, is but a reflection of the growth of the great seaports. The canals, streams, and railroads that pour forth their products in a southerly direction, and feed the river cities, combine with the other business points of the region to swell the trade of New Orleans, the common correspondent of all ; the roads, rivers, and streams that deliver their trade in a northerly and easterly direction, glut the great trunk lines with the mer chandise which they pour into Boston, New York, Philadelphia, and Baltimore.

The city of New Orleans, at the Delta of the Mississippi, is commercially the second city of the Union. Its position is very advantageous, and its growth has been proportional to the development of the country, the resources of which supply it with produce and depend upon it for merchandise in return. The city itself was founded by the French in 1717, and passed into the hands of the Spanish in 1762. By them it was reconveyed to the French in 1800, and was sold by Napoleon to the United States in 1804. At that time its population, mostly French, was 8,056, and it was rapidly increased by the fact of annexation, which not only carried enterprising men thither, but settled the upper country, which was the source of trade. The city was chartered in 1805. In 1820 the population had increased to 27,176 persons, but the exports of the city still consisted mostly of the produce of the upper country, which a population increased rapidly by the influence of war and speculation, had greatly developed, although the valley of the Mississippi had not yet attracted cotton planters. In 1830 the trade of the city marked a larger production of farm produce. In the succeeding ten years the migration from the Atlantic cotton states to the new lands of the valley produced a great change in the trade of New Orleans. The cotton receipts rose from 300,000 bales in 1830, to 954,000 in 1840, and tobacco from twenty-four to forty-three thousand hogsheads, and the sugar crop also had risen to 85,000 hogsheads. The exports were now swollen by the sales of cotton and tobacco, but with the operation of the canals and railroads in the upper country, the supplies of home produce had again become important. The progress of New Orleans has been as follows :—

| Year. | Population. | Imports. | Exports. | Receipts from Interior. | Receipts of Specie. | Valuation. |
|---|---|---|---|---|---|---|
| 1804, | 8,056 | .... | $1,392,093 | .... | .... | .... |
| 1810, | 17,242 | .... | 1,753,974 | .... | .... | .... |
| 1820, | 27,176 | $3,379,717 | 7,242,415 | .... | .... | .... |
| 1830, | 46,310 | 7,599,083 | 13,042,740 | .... | ... | .... |
| 1840, | 102,193 | 10,673,190 | 34,236,936 | $45,761,045 | .... | .... |
| 1850, | 116,375 | 10,760,499 | 38,105,350 | 96,897,873 | $3,792,662 | .... |
| 1851, | .... | 12,528,460 | 54,413,963 | 106,924,083 | 7,938,119 | .... |
| 1854, | .... | 14,402,150 | 60,172,628 | 115,336,798 | 6,967,056 | .... |
| 1856, | .... | 17,183,327 | 80,547,963 | 144,256,081 | 4,913,540 | .... |
| 1857, | .... | 24,981,150 | 91,514,286 | 158,061,369 | 6,500,015 | .... |
| 1859, | 168,472 | 18,349,516 | 101,734,952 | 172,952,664 | 15,627,016 | $111,193,892 |
| 1860, | 168,675 | 22,922,773 | 107,812,580 | 278,617,315 | .... | .... |
| 1865, | 172,000 | 1,475,657 | 3,259,882 | 15,114,563 | .... | 121,038,650 |
| 1868, | 184,000 | 11,386,858 | 58,538,524 | 101,523,231 | .... | 98,788,335 |
| 1870, | 191,418 | 14,993,754 | 107,658,042 | 203,865,461 | .... | .... |
| 1875, | 203,000 | 12,356,487 | 71,461,272 | 160,321,516 | .... | 139,844,204 |
| 1878, | 210,000 | 11,253,255 | 85,368,466 | 177,245,116 | .... | 118,637,715 |
| 1880, | 216,090 | 10,842,254 | 90,249,874 | 216,475,023 | .... | .... |
| 1881, | 223,100 | 12,213,920 | 103,743,986 | .... | .... | .... |

This table embraces the official figures for population, trade, and valuation. The most marked feature is the small amount of imports as compared with exports. This is not the case with New York ; the imports and exports there being almost equal ; the trade of the two cities for the past year (1881), having been as follows :

| | New York. | New Orleans. |
|---|---|---|
| Imports,.................. | $435,450,905 | $12,213,920 |
| Exports,.................. | 407,181,024 | 103,743,986 |

Before the war the cotton of Tennessee,

Arkansas, Texas, and Louisiana, the Indian Territory, the hemp and tobacco (with some cotton) of Kentucky and Missouri, the sugar of Louisiana and Texas, much of the grain of Illinois, Indiana, and Ohio, and the coal of Western Pennsylvania and Illinois, found their way principally by river, though, to a gradually increasing extent by rail also, to New Orleans, and as the producers of these articles bought their goods mainly from New York or Philadelphia, and drew on New Orleans for the pay. The New Orleans merchants shipped the cotton, hemp, tobacco, sugar, and grain to Europe, and drew on the New York representative of the consignees for the amount at 60 days; the New York importer either bought the bills of the consignees on London or Liverpool at sixty days more, and remitted them in payment of his goods, or bought the bills of the New Orleans exporter, who drew direct. In either case the New Orleans merchant obtained the use of his money for three or four months, and a fair profit besides, by this roundabout method of payment.

The war changed all this and for some years nearly destroyed the trade of New Orleans. Now much of the Tennessee, Mississippi, and Arkansas cotton either goes to St. Louis or Memphis, and is shipped thence direct to Europe or to the eastern states; a considerable amount is also shipped from Galveston, Mobile, and Pensacola, or from Charleston, Savannah, or Fernandina, and for the remainder the New Orleans banks are compelled to furnish the money to make advances to the growers before the cotton plants are fairly out of the ground. Hemp is not largely grown, and tobacco finds its chief market at St. Louis and Louisville. Sugar and Louisiana rice are more fully under the control of New Orleans, and within the past three or four years great efforts have been made to increase the shipments of grain to that city, by fleets of grain barges towed down from the northern states to be exported thence to Europe. There are some obstacles in the way. Grain, and still more flour, are very often injured by the heat and moisture of the climate, and this prejudices the producer against the route; while the freight to New Orleans is much less than to New York, grain freights from thence to Liverpool or Havre are about 25 per cent. higher than from New York, and the shipping arrangements are not as perfect. The misfortunes of prevailing sickness from yellow fever, cholera, etc., and of extensive floods, have also had some effect, in checking the full development of its commerce; but the city is admirably situated for commercial supremacy, and with the removal of the obstructions at the mouth of the Mississippi and the increased railroad facilities it now enjoys, it cannot fail to become a great commercial city. It still retains the second place in the amount of its exports, though Boston and Baltimore are crowding it pretty closely; but it no longer lays any claim to be first in the amount of its exports of domestic products of the soil, for the breadstuffs exports of New York alone, exceed its entire exports, and the cotton, wool and live animal exports from that city are nearly equal to the cotton exports of New Orleans. The imports have always been small and have varied very little in fifty years.

While New Orleans thus expanded its trade, and grew in wealth under the influence of western production, the proportion that it enjoyed was by no means the largest. Each Atlantic city had made efforts to obtain a share, and, with more or less success, Canada sought to attract it down the St. Lawrence. New York has built four or five roads to connect the lakes and the west with tide water. Boston has tapped the Canadian roads, reached the lakes at Ogdensburgh, connected at three points with the Hudson River, and finally reaching across Michigan, Wisconsin, and Iowa, has extended her iron fingers to the Pacific. Philadelphia, by two routes, has connected itself with Pittsburgh, Cincinnati, Chicago, and St. Louis. Baltimore has crossed the Alleghanies to Wheeling and Huntington, and built her own road to the western cities, and another line connecting Richmond and Norfolk with the west and southwest is now just on the point of completion.

In 1840, the Erie canal, then the only route and means of transportation, except the huge Conestoga wagons, between the great lakes and tide water, carried 859,549 tons of freight in a year. In 1880, forty years later, the New York canals carried 6,462,290 tons, but three railroads, the New York Central & Hudson River, the New York, Lake Erie & Western, and the

Pennsylvania, carried in the same year 36,363,714 tons more, and with ten other roads, carried 78,150,913 tons, receiving for the freight $143,388,178, the value of the freight being not less than $4,000,000,000.

The exports of the southern ports have grown mostly with the direct export of cotton, and those at the north have added gradually food and manufactures thereto. The general course of trade has been to centralize imports in New York.

Charleston owes its origin to a stock similar to that of New England, since a colony of French Huguenots, flying from persecution, settled there in 1690. It was not chartered as a city, however, until nearly a century later, viz.: in 1783, when its population was nearly 16,000. The commerce of Charleston is not extensive, but its facilities for internal communications are large, and it enjoys the trade of the whole state, together with much of that of North Carolina and Georgia. A canal, twenty-two miles long, connects the Cooper with the Santee river. It has a fleet of steamboats that are running to the neighboring cities, and several lines of packets running to New York regularly. It has railroad connection by several lines with all points northeast, north, west, and south. The population and business have been as follows:—

| | Population. | Imports. | Exports. |
|---|---|---|---|
| 1790, | 16,359 | $4,516,205 | $2,693,268 |
| 1820, | 24,480 | 3,007,113 | 8,882,940 |
| 1830, | 30,289 | 1,054,619 | 7,627,031 |
| 1840, | 29,261 | 2,318,791 | 11,042,070 |
| 1850, | 42,985 | 1,933,785 | 11,447,800 |
| 1860, | 51,210 | 2,070,249 | 16,888,262 |
| 1870, | 48,956 | 617,094 | 11,184,208 |
| 1880, | 49,984 | 440,240 | 26,498,825 |

The importations have decreased, but the exports have more than doubled since 1870. They consist mainly of cotton, and the city is slowly but surely recovering from the depression and ruin caused by the war.

Baltimore was laid out as a town, by Roman Catholics, in 1729, and up to 176 it contained but fifty houses. It is situated on the Patapsco river, fourteen miles from Chesapeake bay, and two hundred miles from the ocean. The harbor is a very fine one. The city enjoys great facilities for commerce, and possesses the trade of Maryland and part of Pennsylvania, while it has of late obtained a good share of that of the western states. It was the great tobacco market of the country, but Richmond now rivals it in that respect. As a flour market, it has few equals. The building of railroads to connect with the interior has greatly promoted the city trade, which has progressed as follows:—

| | Population. | Imports. | Exports. |
|---|---|---|---|
| 1790, | 13,503 | $6,018,500 | $2,239,691 |
| 1800, | 26,514 | | 12,264,331 |
| 1810, | 46,555 | | 6,489,018 |
| 1820, | 62,738 | 4,070,842 | 6,609,364 |
| 1830, | 80,625 | 4,523,866 | 3,791,482 |
| 1840, | 102,313 | 5,701,869 | 4,524,575 |
| 1850, | 169,054 | 6,124,201 | 6,967,353 |
| 1860, | 212,419 | 8,930,157 | 10,442,616 |
| 1870, | 267,354 | 19,512,468 | 14,310,508 |
| 1880, | 332,313 | 19,745,989 | 76,257,566 |

The imports consist of coffee, iron, and steel, and manufactures of these, tin, chemicals, sugar and molasses, fruits, copper, flax, wool, earthen and china wares, cotton goods, salt, hides and skins, etc. The exports are breadstuffs to the amount of over $56,000,000, raw cotton, provisions, oysters, tobacco, petroleum oil, manufactures of wood, tallow, coal, hair, tanner's bark, seeds, etc. The exports have had a wonderful increase,—more than five-fold since 1870, and most of the advance has been made since 1876. Its manufactured products in 1880 were reported at $71,-324,970. This does not include the suburbs or all branches of manufacture in the city itself.

Philadelphia, at the close of the last century, was the first city of America, and though it has not ceased to expand since that time, yet New York, by force of natural advantages, has come to exceed it as a commercial city. Its resources for manufacturing are such, however, as to have given it a high rank in the interior trade of the country. The water power of the neighborhood is very important, and rails and canals give it command of limitless supplies of raw materials, coal and iron in particular. The position of the city was early improved by the construction of canals to the extent of 336 miles, at a cost of $24,000,000; and seven lines, composed of 12 railroads, of 567 miles in length, radiated to every point of the compass, having cost $53,716,201. The canals and roads have swollen the coal receipts of Philadelphia from 365 tons in 1820, to more than tons in 1870, valued at $ per annum. The population and external trade of Philadelphia have been as follows:—

| | Population. | Imports. | Exports. | Total Valuation. |
|---|---|---|---|---|
| 1684, | 2,500 | | | |
| 1790. | 42,520 | | $3,436,893 | |
| 1820, | 108,116 | $8,158,922 | 5,743,549 | $40,487,239 |
| 1810, | 258,037 | 11,680,111 | 3,841,599 | 99,321,881 |
| 1850, | 408,762 | 12,066,154 | 4,501,606 | |
| 1858, | 550,000 | 12,892,215 | 6,036,411 | 155,697,669 |
| 1870, | 674,022 | 17,355,825 | 16,649,828 | 507,987,900 |
| 1880, | 847,170 | 35,961,292 | 49,649,693 | 559,213,282 |

The city of Philadelphia was first settled in 1627 by the Swedes, but was regulated and laid out in 1682 according to the views of William Penn, and its population in 1684 was 2,500. The city is one hundred miles from the ocean, eighty-seven miles from New York, and 130 miles from Washington. It is five miles from the junction of the Schuylkill and Delaware rivers, extending from one to the other, and its harbor is on the Delaware, or eastern side. Vessels drawing more than twenty feet water cannot reach Philadelphia, and the navigation for large ships below is a little difficult. Pilots take inward bound ships at sea. These circumstances have aided to give Philadelphia a moderate foreign commerce as compared with the commanding harbor of New York.

But if the foreign commerce of Philadelphia is moderate, owing to physical difficulties, the internal commerce, from sales of manufactures and goods imported at New York, is very large—and the real growth of the city is indicated by her external trade less than that of, perhaps, any other city of the Union. The census of 1870 showed a population of 674,022. The manufacturing industry of Philadelphia has increased in a remarkable ratio. In 1845 the capital employed in the city proper was $18,000,000, the production $21,000,000, and of the neighborhood $33,000,000.

In 1870 the capital invested in the various manufactures was given at $204,340,637, employing 152,550 hands, and producing $362,484,698 of annual value. The advance in manufactures in the decade 1870–1880, was very great, and in many different directions. The Centennial exposition promoted its manufacturing interests largely. Thompson Westcott, Esq., one of its most eminent publicists, declared in 1876, as the result of extended inquiry, that the capital invested in manufactures to January, 1876, had increased 33⅓ per cent. since 1870, and the value of production nearly 50 per cent. This was undoubtedly true so far as intrinsic values were concerned; but it is to be remembered that 1870 was a period of great inflation, and that the currency values of that year, shrunk more than 50 per cent. as compared with the specie values of 1880. The value of manufactured products of Philadelphia and its immediate suburbs reached the neighborhood of $400,000,000 in 1880, which is equal to over $600,000,000 in the currency and inflation of 1870, for the value of goods produced. Its manufactures have a wide range, and include every description of textiles, machinery of all sorts, locomotives and steam engines, everything that can be made of iron, steel, copper, brass, silver, or other metals; leather in all forms, oils of all sorts, printing, newspapers and books, paper, etc.

Its trade is larger in some directions than that of New York, though smaller in others, but is remarkable for the magnitude of its operations, and for the system and order with which they are conducted. The coal trade and the oil trade (petroleum) are perhaps the largest items of its internal commerce.

Boston was settled early in the seventeenth century, and in 1684 was the most populous of the Atlantic cities, having 6,300 inhabitants. It is 216 miles from New York, and although possessed of one of the finest harbors on the coast, it had no facilities for reaching the back country, which was for the most part rocky and mountainous, until railroads were constructed. Its early trade was in navigation and the fisheries. Its first adventure was in 1627, when a sloop, loaded with corn, was sent to Narragansett to trade, and made an encouraging voyage. Its inhabitants soon became rich by doing the trade of others in their celebrated ships, until manufacturing became possible. The energy and intelligence of the race, when turned in that direction, soon drew large profits from their industry, and more freight for their coasting tonnage, which increased as the numbers engaged in manufacture required more food and raw materials. The greatest start was given to the trade of the city when railroads had laid open even the remotest regions of the interior to its enterprise. The general course of its population, trade, and valuation has been as follows:—

| | Population. | Imports. | Exports. | Valuation. |
|---|---|---|---|---|
| 1684, | 6,300 | | | |
| 1790, | 18,048 | $5,519,500 | $2,517,651 | $6,990,390 |
| 1820, | 43,298 | 14,826,732 | 11,008,922 | 38,288,200 |
| 1830, | 61,392 | 10,453,544 | 7,213,194 | 61,780,210 |
| 1840, | 93,383 | 13,300,925 | 9,104,862 | 102,101,201 |
| 1850, | 136,881 | 30,374,684 | 10,681,763 | 180,000,500 |
| 1855, | 162.629 | 45,113,774 | 28,190,925 | 249,262,500 |
| 1860, | 177,840 | 39,366,560 | 13,530,770 | 278,314,800 |
| 1865, | 203,000 | 24,540,494 | 19,219,499 | |
| 1870, | 250,526 | 47,524,845 | 14,208,829 | 584,089,400 |
| 1875, | 325,000 | 51,982.226 | 29,187,165 | 570,000,000 |
| 1880, | 362,839 | 68,609,658 | 59,238,341 | 613,322,691 |
| 1881, | 371,000 | 61,960,103 | 73,433,677 | |

The commerce of Boston has increased very rapidly since 1850, and it is now running neck and neck with Baltimore for the second place as a commercial city in the United States. But her internal commerce has grown with still greater rapidity; her railways stretch to the Pacific, and these and her steamers put her in direct connection with every important town in the Union. As the headquarters of the cotton, wool, boot and shoe, and other prominent manufactures, it has a very large trade in all parts of the country, as well as abroad. Its retail merchants even solicit and obtain a large custom trade by mail in New York city and Brooklyn. It suffered a loss of about 88 millions by fire in 1872, but rapidly recovered from its losses.

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## CHAPTER III.

### NEW YORK—TELEGRAPH—EXPRESS—GOLD.

The city of New York, at the close of the revolution, was the second city of the new world, taking rank after Philadelphia. Its internal trade was limited to the capacity of the Hudson river, but its traders pushed across to Lake Champlain, and even to Lake Ontario, whence they drew skins and furs from the Indians, and brought down some of the produce of Vermont and New Hampshire. At this date there was little trade west of Albany. The trade was mostly with the towns on the east side of the river, and with Rutland, Burlington, and other Vermont towns, as well as the western towns of Massachusetts. Remittances were made from these towns in ashes, wheat, etc., and during the embargo and war, smuggling was very extensively carried on, taking pay in specie. The goods went up the river in sloops. The New England cities had equal commercial advantages, and Philadelphia enjoyed many others in addition. The valley of the Hudson furnished, however, large supplies of farm produce during the wars of Europe, which gave a preponderance to the New York trade, and it began to gain strength. In 1807 the passage of Fulton's steamer to Albany gave a great impulse to the river trade. Her statesmen, however, soon saw the necessity of a more extended inland communication, and the canal, which had been projected before the peace, became a legal reality in 1817, and a physical fact in 1825. The capital of the New York merchants began to be invested in enterprises which resulted in centering trade in the city. The canal connection opened the vast circle of the lake trade to New York city, and poured into its basin the western farm produce at rates far below what the same articles could be raised for at the east. As a necessity, therefore, New York became the point of supply, not only for the foreign trade, but for the neighboring states. The growing manufactures of Philadelphia and Boston found cheaper food in New York than in their own neighborhood, and North river sloops and schooners continued the Erie canal to the Delaware and Charles river. As new routes to the west, and more extended settlements in that region opened new sources for the supply of produce, and new markets for goods, the tendency was to New York. The capital engaged in commerce at that point being the largest, produce found readier advances and more prompt realization, while the large imports and consignments of foreign goods made the assortment larger and the average cost less there than elsewhere. The same circumstance that drew produce into New York bay, also drew eastern manufactures to the same point, and this increased the assortment which was to be found at the common center. The fact that produce tended generally to New York, as a matter of course made it the center of finance. The United States government, and bank, and mint had been established at Philadelphia. Those circumstances could not, however, control the currents of trade. The pork, and corn, and wheat of the west, the manufactures of the east, the tobacco, cotton, and rice of the south, being sent to New York to obtain advances, it followed that from all quarters bills

drawn against produce ran on New York. Those bills found buyers among the country dealers, who, in all directions, wanted to remit to New York to pay for goods there purchased. Capital could not keep aloof from the focus of transactions, and all loans to be made or financial operations to be conducted, sought New York. For the same reason all funds seeking investments went there to find them. Produce, goods, raw material, capital, all operated in reference to New York, and the foreign trade was the motor which kept up the circulation. This tendency to a center once commenced, cannot be turned, but it strengthens with the general increase of the country. The other cities strive to turn a portion of the current each in its own direction, but the result of those efforts is only to increase the aggregate trade of the whole.

The lines of communication with the interior, and the facilities for advancing on produce, drew to New York a considerable portion of the western produce, and operations are now there carried on which are largely of a speculative character. Pork, flour, etc., are often sold largely for future delivery on the New York exchange; and much of the cotton shipped from southern ports direct to Europe, is resold in New York many times before it arrives out. When the cotton is put on board ship for Liverpool, samples and bills of lading are sent to New York, and the cotton sold "*in transitu*"—that is, during its passage to Europe. Since the ocean telegraph has come into operation, this system has been carried to a much greater extent, since news from the Liverpool market is received at least fifteen days after a cargo is shipped before its arrival out; and in speculative times, other articles are subject to the same operations. The export of corn first became a large business in the famine years of 1847–8, and the sub-divisions of qualities, round and flat, yellow, white, etc., then manifested themselves. In 1859 the crops were greatly beyond any former experience, and every available means of transportation was taken up to convey them to market. The realization on them depends upon the quantities that Europe may require, and this depends upon the events of a few weeks. The steamers now give intelligence in eight or ten days, when formerly thirty were required. Since the ocean telegraphs have worked, the price of corn in Liverpool is known simultaneously in New York and Chicago, and water transportation is pressed to the utmost before the frosts close it.

The proportion which each of the cities named enjoys of the aggregate export trade of the whole country, is seen in the table on the following page.

The opening of the Erie canal in 1825, gave the first decided impulse to the city business, and produced a powerful effect upon its prosperity. The impulse was prolonged under the bank excitement that exploded in 1837. The effect of railroad extension at the west has, in the last thirty-five years, had a still more powerful influence upon its growth. The following table gives the population, imports, exports, and taxable valuation for a long period:—

| | Population. | Imports. | Exports. | Valuation. |
|---|---|---|---|---|
| 1684, | 2,600 | $4,579 | $10,093 | |
| 1750, | 10,381 | 267,130 | 35,632 | |
| 1790, | 33,131 | 10,739,250 | 2,505,415 | |
| 1800, | 60,489 | 26,201,000 | 14,045,079 | $25,645,867 |
| 1820, | 123,706 | 23,629,246 | 13,160,918 | 69,530,753 |
| 1830, | 203,007 | 36,624,070 | 19,697,983 | 125,288,518 |
| 1840, | 312,710 | 60,440,750 | 34,264,080 | 252,233,515 |
| 1850, | 515,547 | 111,123,524 | 52,712,789 | 286 061,816 |
| 1855, | 629,904 | 164,776,511 | 113,731,238 | 486,998,278 |
| 1860, | 813,668 | 233,718,718 | 138,036,550 | 577,230,656 |
| 1870, | 942,310 | 315,200,022 | 254,131,205 | 965,283,464 |
| 1875, | 1,041,886 | 368,637,580 | 329,201,913 | 1,100,943,699 |
| 1880, | 1,206,299 | 459,937,153 | 388,441,664 | 1,219,349,285 |

Up to the year 1840 most of the business of the west passed through the canal or by way of New Orleans. The city held then a kind of monopoly, but, like all monopolies, it cramped the producers. The large expenditure at the west for bank capital, in the years 1836–37, caused a great credit demand for goods upon New York, which was generally met. The facilities granted in those years by the American bankers in London, for the purchase of goods on credit, placed these within the reach of any dealer who could make a fair show; and the goods obtained on credit required to be sold on the same terms. The rivalry thus produced among those who could command goods, was very great, and the utmost efforts were made to obtain paper in exchange for goods. The banks showed the same eagerness to discount the paper that the merchants did to obtain it, and the mass grew in a rapid ratio, from the small country dealers to city jobbers and importers, and London bankers, until the Bank of England, in August, 1836, issued a warning to those

EXPORTS OF THE LEADING ARTICLES OF DOMESTIC PRODUCE FROM FIVE ATLANTIC CITIES AND FROM THE WHOLE UNION IN 1880.

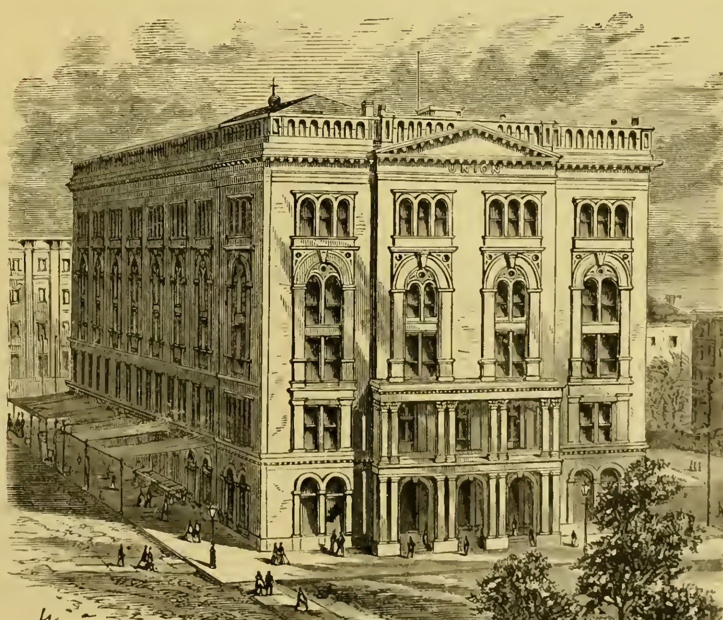
| Articles. | Boston. | Philadelphia. | Baltimore. | New Orleans. | New York. | The Union. |
|---|---|---|---|---|---|---|
| Bread and Breadstuffs | $14,927,617 | $28,987,812 | $56,364,054 | $9,291,558 | $134,671,452 | $288,036,835 |
| Cotton, Raw | 7,033,344 | 2,075,092 | 6,763,755 | 75,553.195 | 36,213,941 | 211,535,905 |
| Cotton, Manufactures of | 1,174,024 | 96,271 | 34,650 | 39,606 | 7,442.398 | 9,981,418 |
| Provisions | 18,772,674 | 6,295,658 | 4,208,727 | 95,472 | 90,303,925 | 127,043.242 |
| Mineral Oils | 645,047 | 6,578,762 | 1,528,888 | 5,159 | 27,178,159 | 36,218,625 |
| Tobacco, Unmanufactured | 999,568 | 930,583 | 4,107,405 | 61,272 | 8,898,270 | 16,379.107 |
| Tobacco, Manufactures of | 260,260 | 148,400 | 88,894 | 1,189 | 1,399,619 | 2,063.166 |
| Wood, and Manufactures of | 1,161,251 | 770,557 | 252,116 | 803,667 | 5,410,152 | 16,237.336 |
| Animals, Living | 5,533,771 | 382,960 | 852,035 | 89,805 | 7,341,756 | 15,882,120 |
| Iron and Steel, Manufactures of | 841,568 | 363,446 | 64,510 | 17,987 | 8,076,724 | 14,716.524 |
| Tallow | 1,482,745 | 633,696 | 236,776 | 70,893 | 4,957,120 | 7,689,232 |
| Leather and Manufactures of | 896,808 | 212,462 | 8,867 | 3,024 | 5,175,480 | 6.760,186 |
| Oil Cake | 37,373 | 471,492 | 23,442 | 1,687,158 | 3,798,805 | 6,259,827 |
| Furs and Fur Skins | 186,152 | 169,904 | 2,295 | .............. | 4,971,047 | 5,404.418 |
| Drugs, Chemicals, Medicines | 240.529 | 97,272 | 14,026 | 7,262 | 2,817,283 | 3,530,450 |
| Vegetable Oils | 50,966 | 6,522 | 3,849 | 2,487,283 | 905,521 | 3,476,040 |
| Animal Oils | 124,729 | 81,334 | 87,258 | 210 | 1,277,987 | 1,676.079 |
| Sugar and Molasses | 384,204 | 257,091 | 30.476 | 856 | 2,443,105 | 3.258.230 |
| Spirits, Distilled | 378,146 | 320 | 15,700 | 562 | 2,584,050 | 3,027.545 |
| Beer, Ale, Porter, and Cider | 21,111 | 1,948 | 18 | 24,729 | 162,022 | 298.818 |
| Seeds | 88,043 | 32,505 | 114,481 | 1,049 | 2,254,001 | 2,776,823 |
| Hops | 68,726 | 73,675 | 28,267 | 35 | 2,349,996 | 2.573.292 |
| Naval Stores (Resin, Turpentine, &c ) | 29,326 | 35,721 | 19,876 | 8.378 | 606,396 | 2,452,908 |
| Agricultural Implements | 176,818 | 5,523 | 688 | 3,708 | 1,980,687 | 2,245,742 |
| Spirits of Turpentine | 17,155 | 568 | 251 | 105 | 364,033 | 2,132.154 |
| Fruits | 402,781 | 16,165 | 29,750 | 1,105 | 1,398,364 | 2,090,634 |
| Coal | 8,251 | 168,196 | 152,172 | 126 | 180,173 | 2,058,080 |
| Hemp, and Manufactures of | 91,249 | 293 | 870 | 1,144 | 1,156,756 | 1.629.259 |
| Clocks and Watches | 17,871 | 848 | 17 | 395 | 1,167,927 | 1,453,237 |
| Carriages, Cars, Carts, etc | 109,894 | 3,842 | 208,204 | 502 | 858,784 | 1,407,425 |
| Quicksilver | 17,010 | .............. | .............. | 1,040 | 89,515 | 1,360,176 |
| Paper and Stationery | 55.336 | 16,477 | 2,967 | 1,325 | 919.866 | 1,183.140 |
| Metals, and Manufactures of, N. E. S. | 6,071 | 439 | 28,329 | 461 | 429,741 | 970,679 |
| Copper, and Manufactures of | 3,086 | 366 | 47 | 615 | 800,218 | 819.218 |
| Hides and Skins | 147,992 | 9,650 | .............. | 320 | 267,789 | 619.074 |
| Manures | 3,685 | 28,325 | .............. | 6.656 | 174.811 | 603.668 |
| Wool and Manufactures of | 919 | 982 | 69 | 424 | 53.890 | 288.563 |
| Fancy Articles, Combs, etc | 20,572 | 3,575 | 2,594 | 505 | 603.365 | 875,856 |
| Musical Instruments | 152,840 | 441 | 270 | 1,857 | 569,737 | 811,177 |
| Ordnance Stores | 13.695 | 745 | 367 | 748 | 428,534 | 777,341 |
| Glass and Glassware | 40.928 | 1,405 | 49.377 | 842 | 422,733 | 749.866 |
| Wearing Apparel | 38,652 | 6,816 | 1,774 | 1.039 | 338,752 | 707.966 |
| Soap, Common | 71,491 | 15,546 | 3,556 | 37,063 | 513.666 | 690,122 |
| Marble and Stone, Manufactures of | 28,774 | 11,269 | 3,256 | 340 | 397.810 | 652,963 |
| Books and Other Publications | 33,517 | 16,329 | 5,228 | 212 | 426,200 | 626.630 |
| Ginseng | .............. | .............. | .............. | .............. | 29.315 | 533,042 |
| Starch | 5,321 | 3,057 | 28,781 | 10 | 381,809 | 447,842 |
| Jewelry | 500 | 650 | 505 | .............. | 147,948 | 231.531 |
| Sewing Machines | 8,411 | 17,507 | 111 | 769 | 1,502,580 | 1,649.367 |
| All Unmf'rd Articles not Enumerated. | 53,775 | 29,362 | 27,979 | 6,428 | 423.057 | 782.661 |
| All Mfrd. Articles not Enumerated | 439,397 | 268,995 | 391,357 | 23,691 | 4,145,631 | 5.518,283 |
| Totals of 1880 | $58,023,587 | $49,612.195 | $76,220,870 | $90,249,874 | $388,441,664 | $823.946,353 |
| Totals of 1870 | 12,251,267 | 16.903,072 | 14,330,248 | 107,658,042 | 209,972,491 | 455,208,341 |
| Increase | $45,772,320 | $32,709,123 | $61,890,632 | *$17,408,168 | $178,469,173 | $368,738,012 |

* Decrease. The cotton export of New Orleans in 1870 was larger than that of any year since 1860, and was never equaled except in that year.

houses to curtail their credits. This was the "hand writing on the wall"—settling day had come. The business south and west had then been eagerly sought after by the jobbing-houses, who employed drummers to haunt the New York hotels and beset every new-comer with temptations to buy. The drummers of the day had usually no limit placed upon their expenses, which were intended to cover the "attentions" shown to the country dealer. These revelled in the dissipations of the town at the apparent expense of their entertainer, and they could do no less than buy of such attentive friends, when the bill, whether they discovered it or not, would often cover their own and other people's expenses. The mode of business then in vogue, when banks were multiplying so rapidly all over the country, was to take the paper of the dealers, payable at their own local bank. It was supposed that the dealer would be sure to keep his credit good at home. The result showed that the dealer, in order to pay the New York bill, got an accommodation note done at his bank, which thus became the debtor of the New York collecting bank. By this means, although the New York merchant got his money, the west was still in debt to the east; and this continued as long as capital was sent from the east to the west to start banks. The whole system exploded in 1837, and the bank capitals were sunk in these credits. From that date there was to be "no more credit," a threat which has often been repeated without being put in practice. The only permanent change seemed to be to require notes payable in New York. Those were given at dates longer or shorter, but the system was an improvement on the old mode. With 1840 also began the railroad building, which brought stocks and bonds to New York for negotiation, and the money being expended west promoted consumption of goods, which caused a greater demand in New York. The exports of produce increased at higher prices, and the sales of these gave the producers the means of buying more goods. In 1838, thirty-one years after the first successful steamboat, arrived the first ocean steamer, the Sirius, at New York, marking a new era in foreign trade, since communication with Europe was now reduced to half the time, a circumstance which was equivalent to an increase of capital engaged in commerce, because it could be turned oftener. From that date ocean steam navigation rapidly increased. The electric telegraph of Morse began a few years later to exert its influence in facilitating intercourse, and the express system was also introduced. It is somewhat singular, that with the breakdown of the old credit system and the adoption of the plan of making notes payable in New York, four important elements, having the highest centralizing tendencies, began to operate. These were, first, ocean navigation; second, the more extended construction of railroads; third, the invention and construction of telegraphs—there are now 105,000 miles of lines, that have cost over $60,000,000, consolidated in one company, with a capital of 80 millions, and New York is the center for the whole; and fourth, the express system. All these, centering in New York, came into active operation at about the same time. The express business is peculiarly American, and has grown with a vigor which places it among the most important trading facilities of the country. In the spring of 1839, a year after the arrival of the Sirius at New York, W. F. Harnden, then out of employ in Boston, was advised by his friends to get a valise and take small packages and parcels from his acquaintances in Boston to their correspondents in New York, and return with what they had to send, making a small charge for his services. He did so, and discovered that a great public want was to be supplied. He soon contracted with the railroad to send a car through with his goods, and opened offices, employed messengers, pushing the business with American energy. In 1840 an opposition was started by Adams. In 1841 new fields were explored by Harnden, who ran an express between Albany and Boston, and one between Albany and New York. Route after route was then opened to express agents, penetrating further and further, and multiplying their lines in the densely settled portions of the country; not only between cities, but between different portions of the same city. In 1845, Buffalo was reached by Wells & Co. In 1849, the gold fever brought California within the scope of express operations, and from San Francisco "pony" expresses ran to the diggings with great success placing the solitary miners of the Sierra Nevada in direct connection with the mint and with Wall street. As these busy agents continued to increase, and lessen the difficulty of communication, trade multiplied as a consequence. The telegraph had also penetrated most direct routes between cities, and that instrument came in aid of the express which executed an order transmitted by telegraph. Instead of waiting the slow course of the post for a reply, the telegraph gave an instantaneous order for goods that the express conveyed. Thus, the three months that would once have been consumed in coming from Cincinnati for goods and returning, was reduced to three days. All the cities of the Union were brought within similar speaking distance. In 1850 it was estimated that the expresses travelled twenty thousand miles daily, and the service has since increased twenty-fold. Steam, the telegraph, and the express, had thus greatly facilitated trade, by making the long semi-annual expeditions to the large cities, for the purchase of goods, unnecessary. The small dealers could now buy frequently in small parcels the goods they found most in demand, instead of buying a six months' stock, and taking the risk of the goods being well selected for the market. This also brought with it another change. It had been the case, that most of the goods sent to America formerly were the surplus stock of the British manufacturers. That is, where patterns had been got up for the home consumption and the regular trade supplied, there would remain a stock that had become comparatively dead by age. This dead stock was "good enough for the American market," and was sent out almost for what it would bring, and being transported into the interior for six months' sales, became a sort of Hobson's choice for the consumers. When, however, frequent arrivals of new goods came to be laid before the customers, they immediately displayed a taste and exercised a choice. Ill-assorted goods would not now sell at all. English refuse became of no value, because American taste was developing itself. The customer would no longer take what was laid before him; but in order to sell, the dealer had now to exercise his sagacity, as to what would please his taste in selecting it, and his judgment in buying it. The manufacturer of dry goods was obliged to follow in the same direction, and the employment of designers became important. It was now that the sagacity and taste of the factory agents were felt to be an indispensable element in the success of a concern. The production of a design was promptly followed by the judgment of the public, and manufacturing became, as it were, one of the fine arts.

The joint operation of these new agencies manifested itself in 1850, when the west had become enriched with the large sales it had made of its produce during the famine years, and the railroads and canals, then in operation, had profited largely by the high freights and tolls paid by produce on its way to market. The gold of California soon began to add a new stimulus to the business of the city. In 1852 the Michigan roads had opened through to Chicago, and New York was, by rail, within thirty-six hours of that city. The projection and construction of railroads went on rapidly, constantly adding to the business of New York—the common center, whence the means to build were drawn, and to which these means returned in the purchase of goods. The Crystal Palace, in 1853, drew great numbers of persons to the city, and gave a start to retail trade, which had an important effect upon the value of real estate and the location of business. In the above table we find that the imports into the city from abroad rose fifty per cent. in the five years to 1855, and the total valuation was two hundred millions. This valuation followed the changed location of business. In the speculative times of 1836–7, the old Pearl street house, in Hanover square, was the headquarters of country dealers, and that square the center of the dry goods trade, around which all others clustered. The great fire of December, 1835, by which the lower part of the city and a value of $18,000,000 was destroyed, broke up the location, which, however, was speedily rebuilt, and, with the rebuilding, the Merchants' Exchange was enlarged and reconstructed at an expense of $1,800,000. The usual fate overtook occupiers in the inordinate demands of landlords, and the leading firms pushed across Wall street and made Pine and Cedar streets the great center. Gradually firm after firm ventured upon Broadway, which, in 1845, was visited by a fire that caused the rebuilding of the lower portion, no longer for dwellings, but for substantial stores. One firm went up to the corner of Rector street, one-quarter of a mile from the Battery, and took the site, long vacant, of the old Grace church, at a lease. "Too high up," said conservatism, as the crowd rushed by, and the great retail firm of Stewart & Co. took the old Washington hotel at the corner of Chambers, and occupied the block with a marble store which then had no equal in any city. Here importing and jobbing were carried on to the extent of $50,000,000 by one who, by his energy and enterprise, had increased a capital of a few hundreds to millions, and employed twelve hundred and fifty clerks and others. There were handsome stores before this was built, but this commenced the era of expensive structures. The demands of luxury led to the erection, up town, of elegant trade palaces of iron, marble, and freestone, for the leading firms in the dry

ACADEMY OF DESIGN, N. Y.




COOPER INSTITUTE, CONTAINING SCHOOL OF DESIGN,
(In which Young Ladies are taught Drawing and Engraving.)

GOV. STUYVESANT'S MANSION, N. Y.,
(In olden time.)

FIRST CLASS DWELLINGS IN EXCHANGE PLACE, 1690.


A. T. STEWART'S RESIDENCE, FIFTH AVENUE, N. Y., FIRST CLASS DWELLING, 1870.

NEW CITY HALL, N. Y.

THE NEW YORK STOCK EXCHANGE.

goods, jewelry, clothing, porcelain, and other branches of trade; while the wholesale dealers, invading the old college ground, covered it with stores of great size and beauty. The center of business, which thirty years since was within a fourth of a mile of the Battery, is now three miles distant, and the value of real estate has followed like a "ground swell," reaching incredible rates. A marble store on Broadway was rented in 1860 for $50,000 per annum, and in 1867 for $75,000. A lot on Broadway, near Broome, sold in 1859 at private sale for $110,000; it had been bought at auction in 1852 for $35,000. An elderly gentleman present remarked, "This lot was part of the old Colonel Bayard farm, and was given by the colonel to his barber for a hair-dressing bill. I have seen it sold four times, and each time people decided the buyer crazy to give such a price." The Society Library lot, corner of Leonard and Broadway, sold with the building in 1849 for $60,000; after the costly stores erected on it were burned in 1867, it was sold for $650,000, and a building costing about $1,100,000 erected on it. The "Central Park," covering 843 acres, was projected, and has since been completed, at a cost of over $12,000,000, having employed in the fourteen years, over 50,000 men.

The city spread toward the upper wards through the agency of railroads, which enabled workmen and merchants to live further from their places of occupation. The importance of consuming as little time as possible in coming from and going to occupation, made it requisite formerly, that persons should live near their business. The old cities of Europe are thus built with narrow streets and very high houses, to accommodate many in a little space. Modern cities are built on a broader scale. Omnibuses first came into play to give a greater breadth to the dwellings of the people, and horse-railroads still further expanded the area. Manhattan island, forming a point at the Battery, runs northerly between the North and East rivers. From the City Hall park the city spreads in a fan-like form east and west, and from that point radiate twelve railroads, including the Harlem, which runs by the Fourth avenue to Albany. The eleven other roads run on as many routes, and carry their passengers from three to twelve miles, returning with them to a common center every morning to business. These eleven railroads cost about $12,500,000. In 1869 they transported about 131,000,000 passengers. There are in New York city thirteen other railroads not having their terminus at the Park, which cost somewhat more than the eleven, and carry altogether nearly as many passengers. But these railroads did not carry the people fast enough to and from their homes, and now there are five elevated railway routes, all, however, consolidated under one corporation, which carry passengers to Harlem, Fordham and Kingsbridge, by steam, at the rate of 20 miles an hour or more. These cumber many of the streets, and will some day be replaced by something better. In Brooklyn there are thirty horse-railroads which have cost nearly $25,000,000, and carry about 150,000,000 passengers. The telegraph and the telephone play an important part in the city business. Many large firms whose offices are in the lower part of the city, and warehouses and manufactories in the upper part, connect the two by telegraph and telephone, to transmit orders and for information. All the police stations connect by telegraph to give alarms of robbery, and fire alarms are also conveyed by the same means. The "time ball" also operates by telegraph. On the top of the Custom House, sixty feet high, is a mast on which slides a black ball some twenty feet in diameter. This can be seen from any part of the bay. It is hoisted to the top of the pole, and is so arranged that the moment the sun reaches the zenith, by observation, at Albany, it is released by electricity and falls, marking twelve o'clock, by which every ship master in the port may set his chronometer.

All these railroads, horse, motor, and elevated, continually running night and day, aided by six stage routes, bring the business and working population to their occupations, and back at night; yet all these routes are insufficient to transport the hundreds of thousands who need conveyance, within a reasonable time, and new routes, elevated and viaduct, are constantly projected, with cars drawn by steam power, to facilitate rapid transit.

The aggregate of passengers conveyed each year by the railroads and stages in New York and Brooklyn, is about ten times the population of the United States;

the greater number going to and coming from their business by these conveyances every working day. This facility of transit allows business men to concentrate their stores and warehouses around certain points, thus affording better opportunities for purchasers from distant cities and villages to purchase their stocks without spending much time in going from one warehouse to another to select the great variety of goods which go to make up a general assortment. The importers, jobbers, and large dealers reside, of course, at a distance from their warehouses, but they are brought promptly and readily to them by cars, stages, or steamers. Yet these centers of trade change materially every four or five years. The wholesale jobbers and importers in most descriptions of goods, and especially in dry goods, are none of them below the Park, and while a few of the oldest houses are in the vicinity of Worth and Canal street, the great majority are now established between Tenth and Twenty-third streets. The great jewelry, silver-plate, electroplate, watches, publishing houses, sewing-machines, carpets, etc., etc., have almost without exception, located themselves between Bond and Twenty-third streets, and most of the buildings down-town are either occupied in the heavier trades, as offices or banking and insurance houses.

The great retail houses in the dry-goods trade are now almost entirely above Ninth street. They are not all on Broadway, several of the largest being on Sixth avenue or on Fourteenth, Nineteenth, Twentieth, Twenty-First, Twenty-Second and Twenty-Third streets. The change is a very great one from the time when even large dealers lived in the dwelling-houses over their stores and boarded their clerks.

Perhaps the greatest difference which purchasers who come to the New York market are called to observe, is in the division of labor. Formerly a dry-goods jobber kept a full assortment of everything in his line, and it required no little tact and exercise of memory to keep each line full. Now, the trade is largely subdivided. One house deals only in woolen goods, and these only of certain classes ; the trade in cotton goods is divided into sheetings, shirtings, cambrics, etc.; colored cambrics, prints, twilled goods, jeans, tickings, etc., silks into dress silks, ribbons, handkerchiefs, fringes, etc. Then there are dealers in sewing silks, cotton and linen spool thread, hosiery, knit goods, water repellents, braids, bindings, passementerie, artificial flowers, feathers and birds, beetles, etc., for ornaments, buttons, Berlin wool, corsets, and every description of ladies and gentlemen's underwear. Some of the largest jobbing and importing houses do indeed keep up separate departments for each of these classes of goods, but it requires a large capital and a special head of each department to do this effectively. Long credits which have always been the ruin of the jobbing houses in any time of financial panic, are not now so generally the rule as they were in the past. Many houses sell only for cash, or on thirty or sixty days. Four months is generally the longest limit. The methods of selling have materially changed. Formerly the country merchants and those from the smaller cities journeyed to New York and Philadelphia twice a year, and spent from two to six weeks there in purchasing goods, many of them indulging meanwhile in a round of dissipation at the expense of the jobbers and importers. They were charged high prices for their goods and bought on long credits ; but they charged their customers in turn from 100 to 300 per cent. profits. As the western cities, Cincinnati, Chicago, Louisville and St. Louis became independent of the great eastern cities, they had their large wholesale houses and drew to themselves much of the jobbing trade. To hold their customers the New York jobbers and importers were obliged to send out traveling salesmen, or commercial travelers, to make their prices lower and to take orders at all seasons of the year to be sent by express or fast freight. This mode of selling has been carried to a great extent, between 200,000 and 300,000 commercial travelers being on the road most of the time in the different branches of trade, and reaching every hamlet which is near a railroad. This business has been overdone, the salesmen being so numerous as to annoy the country merchants and hinder their business. A new method is to some extent taking its place. The importers and jobbers send out weekly or monthly catalogues, accompanied often by dress goods, ribbons, etc., with samples and prices (usually written in), to all their customers, and receive their orders often

INTERIOR OF A CARPET HOUSE.

INTERIOR OF A DRY GOODS HOUSE.

by telegrams. This method is less objectionable than the others and may with a great deal of labor be made as effective. Most of the largest retail houses are also sending out samples, and receiving orders by mail or telegraph. The importers and jobbers rely for their credits, to some extent, on the mercantile agencies, though less than formerly, but the largest houses have now a confidential credit clerk, whose business it is to find out the standing of every customer of the house.

The supplies of goods for the country dealers are derived from various sources ; small wares from city manufacturers ; domestics from the mills or agents ; foreign goods from importers or agents of foreign manufacturers. The local manufactures are generally purchased by the jobbers to make good their assortments, as is also the case with hardware, and most articles of domestic manufacture, except the productions of the large mills, which have agents in the city for their special sale.

The supply of capital in the city brings to it the largest assortment of goods, and of course it is the best point at which to buy, the more so that at times there is an over supply of goods, which, being worked off at auction, realize a loss sometimes of 25 to 30 per cent. to the importer and foreign owner, and of course to the advantage of the country buyer. The general attractions offered to buyers make it to the advantage of sellers elsewhere to send their merchandise to New York to meet the purchasers. Boston made, recently, an attempt to break up this, by establishing sales of her manufactures there, instead of sending them to New York. The force of centralization is, however, difficult to overcome, and the imports at New York show a rapidly increasing share of the arrivals into the whole country. Thus, in 1840, New York imported $60,000,000 out of an aggregate of $121,000,000 ; in 1870, at specie values, $293,990,006, out of $435,958,408 ; in 1880, $543,595,398 out of $667,954,746. The proportionate imports at the Atlantic ports will be observed on the following page.

The increase in the ratio of both imports and exports at New York to the whole amount is very remarkable. In 40 years its imports had increased from less than one-half of the whole to five-sevenths of the whole, and every year gives it a larger proportion. Those ports which have made specialties of certain articles, and have attempted to control the trade in them, find that without any apparent effort, and without having any specialties, New York receives four or five times as large a quantity of these very articles as they do after the most strenuous effort. The great mass of the goods for the consumption of the interior passes into the port of New York. It is to be borne in mind, however, that many of the importations at New York are really for Philadelphia, Albany, and other cities, even western ones. They are entered at the custom-house by a broker, who pays the duty and forwards them by express to their destination for a small commission. The express, the rails, and the telegraph and telephone facilitate such operations.

The gold and silver imported at New York are from various sources. The bulk of the gold that forms the amount exported, is direct from California.

The gold extracted from the earth by the miners of California has a considerable degree of purity, and before refining establishments were set up in the state, sold at from $16 to $20 per ounce. Much was used as a currency. It was carried in little leather pouches, and weighed out to shopmen in exchange for goods. A large portion of it was carried to New York, in the pockets of home-bound adventurers, and sold in New York at such rates as were possible. The buyers mostly had it sent to Philadelphia, by express, at an expense of $\frac{3}{8}$ per cent. It was then assayed and coined at the public mint, and the proceeds returned to the owner. This expensive and round-about process led to the establishment of a mint in San Francisco and an assay office in New York, where the miners themselves could deposit the dust and get the full value in return. When the dust is deposited, a certificate of weight is given and the gold in bars returned. There are a number of private assaying houses in San Francisco, where the dust is cast into bars of large size. Most of these are connected with banking houses, and the bars are the basis of exchange. The express companies deal in this gold. The miner now having a lot of dust, sells it to an express agent, or sends it down to a banker in San Francisco, who has it assayed and cast into bars. The

IMPORTS OF CERTAIN GOODS INTO THE FIVE GREAT ATLANTIC PORTS, AND ALSO THE TOTAL IMPORTS INTO THE UNION IN 1880.

| ARTICLES. | Boston. | Phila. | Baltimore. | N. Orleans. | New York. | Total in the Union. |
|---|---|---|---|---|---|---|
| Gold bullion and bars | $17,911 | ... | ... | $3,355 | $19,298,528 | $20,336,445 |
| Gold coin | 8,553 | 16,152 | $1,631 | 5,286 | 57,894,197 | 60,420,951 |
| Silver bullion | ... | ... | ... | ... | 145,163 | 1,981,425 |
| Silver coin | 80,158 | 640 | 8,636 | 222,260 | 6,320,357 | 10,294,489 |
| Chloride of lime | 407,423 | 146,667 | 7,720 | 11,603 | 403,769 | 985,585 |
| Cocoa, crude and leaves and shells | 138,724 | 1,756 | ... | ... | 1,120,776 | 1,306,239 |
| Cochineal | 218,369 | 51,185 | 95 | ... | 534,511 | 890,168 |
| Coffee | 225,105 | 145,053 | 8,473,698 | 4,010,166 | 43,512,094 | 60,360,769 |
| Cotton, raw | 56,480 | 5,099 | 14 | ... | 458,921 | 591,120 |
| Cotton, manufactured | 1,007,570 | 1,328,021 | 155,613 | 386,727 | 26,314,501 | 29,929,366 |
| Cutchce and terra japonica | 486,797 | 20,294 | ... | ... | 1,296,451 | 1,803,542 |
| Dye-woods in sticks | 491,593 | 199,660 | 9 | 1,022 | 1,082,089 | 1,808,730 |
| Fish not of American fisheries | 778,816 | ... | 3,761 | 51 | 817,343 | 2,168,208 |
| Fur skins, undressed | 12,771 | 2,326 | ... | ... | 1,471,227 | 2,496,277 |
| Furs and dressed fur skins | 154,226 | 85,129 | 1,689 | 1,439 | 3,640,325 | 3,927,835 |
| Gums | 91,493 | 85,906 | 1,931 | 21,044 | 2,232,020 | 2,444,302 |
| Hair unmanufactured | 329,389 | 4,146 | 7,835 | ... | 586,927 | 960,077 |
| Hair and manufactures of | 140,496 | 42,660 | 3,248 | 30 | 729,421 | 922,887 |
| Hides and skins, not furs | 7,391,363 | 182,182 | 149,736 | 96,015 | 20,430,171 | 30,002,254 |
| Household and wearing apparel, f. o. d. | 68,321 | 13,242 | 21,005 | 3,159 | 278,983 | 2,078,841 |
| India rubber, &c., crude and manufactured | 1,005,788 | 637,664 | 7,946 | 90,403 | 8,142,905 | 9,918,290 |
| Indigo | 654,540 | 34,309 | ... | ... | 2,063,301 | 2,752,900 |
| Oils, mineral, chemical and vegetable | 622,779 | 46,121 | 8,945 | 50,865 | 1,819,924 | 2,821,603 |
| Paintings | 99,639 | 58,066 | 10,098 | 771 | 2,019,408 | 2,319,352 |
| Paper materials | 1,646,613 | 219,027 | 23,749 | ... | 4,783,649 | 6,057,197 |
| Paper and manufactures of | 93,598 | 92,073 | 11,441 | 9,619 | 1,282,592 | 1,671,120 |
| Silk, raw | 3,245 | 12,901 | ... | ... | 1,969,057 | 12,024,699 |
| Silk, manufactures of | 587,754 | 559,975 | 35,246 | 36,271 | 30,758,123 | 32,188,690 |
| Soda and salts of | 1,149,228 | 994,167 | 432,476 | 224,657 | 4,418,089 | 7,648,069 |
| Sulphur, crude and refined | 184,187 | 254,892 | 313,342 | 7,121 | 1,083,814 | 1,933,032 |
| Sugar and molasses, etc | 13,462,190 | 8,761,411 | 1,105,334 | 817,056 | 58,328,413 | 88,771,165 |
| Tea | 13,298 | 163 | 1,592 | 173 | 13,715,368 | 19,782,631 |
| Tin in bars and manufactured | 1,721,155 | 2,633,379 | 1,449,410 | 364,623 | 16,181,330 | 23,507,250 |
| Wood, manufactured and unmanufactured | 337,950 | 88,689 | 12,387 | 100,490 | 2,392,448 | 9,535,777 |
| Animals living | 3,176 | 986 | 69 | 60 | 33,979 | 3,739,996 |
| Spirits and malt liquors | 660,390 | 313,212 | 77,380 | 551,409 | 6,132,377 | 8,42[illegible],017 |
| Books, pamphlets, etc | 194,139 | 133,470 | 21,415 | 4,191 | 2,090,659 | 2,487,888 |
| Barks, medicinal and other | 4,900 | 389,333 | 490 | 9,473 | 1,932,726 | 2,818,051 |
| Articles prod. or manuf. of U. S. brought back | 205,251 | 27,220 | 702,724 | 48,622 | 4,188,223 | 5,644,271 |
| Chemicals | 1,094,088 | 1,045,331 | 176,145 | 39,186 | 10,038,912 | 12,867,018 |
| Breadstuffs and other farinaceous food | 90,612 | 12,459 | 10,978 | 17,791 | 549,412 | 8,856,497 |
| Bristles | 239 | 861 | 373 | ... | 1,007,972 | 1,009,495 |
| Buttons and button materials | 75,918 | 141,568 | 2,887 | 2,160 | 3,638,866 | 3,877,105 |
| Clothing | 109,658 | ... | 10,285 | 8,514 | 1,192,523 | 1,44[illegible],899 |
| Coal, bituminous | 163,595 | 8,608 | 1,488 | 11,441 | 196,664 | 2,071,022 |
| Copper and manufactures of | 13,926 | 19,655 | 334,223 | 301 | 852,616 | 1,415,212 |
| Earthenware, stone and china ware | 956,950 | 559,922 | 169,720 | 175,0[illegible]8 | 3,485,789 | 5,650,267 |
| Fancy Goods | 182,543 | 100,479 | 113,317 | 33,466 | 5,[illegible]45,124 | 5,9[illegible]3,163 |
| Flax and manufactures of | 2,129,237 | 1,301,261 | 252,293 | 235,907 | 19,393,375 | 23,730,326 |
| Fruits of all kinds | 873,161 | 934,225 | 280,673 | 301,171 | 10,588,054 | 13,270,678 |
| Glass and Glassware | 441,074 | 165,681 | 33,690 | 55,516 | 4,389,638 | 5,221,511 |
| Hemp and manufactures of | 638,929 | 76,891 | 2,[illegible]21 | ... | 2,237,040 | 3,2[illegible]1,579 |
| Iron and steel and manufactures of | 6,755,725 | 8,023,841 | 3,716,034 | 1,728,951 | 30,291,991 | 53,714,008 |
| Jute and other grasses, manufactures of | 496,024 | 1,549,707 | 2,748 | 71,606 | 5,794,567 | 7,931,485 |
| Lead and manufactures of | 2,366 | 15,982 | 375 | 54 | 299,710 | 327,113 |
| Leather and manufactures of | 1,674,716 | 313,775 | 25,237 | 22,513 | 10,035,891 | 12,2[illegible]5,033 |
| Marble and stone, and manufactures of | 13[illegible],524 | 70,372 | 66,506 | 30,104 | 536,057 | 888,874 |
| Metals and manufactures of, n. e. s. | 183,045 | 58,444 | 10,977 | 7,[illegible]60 | 1,358,641 | 1,687,6[illegible]5 |
| Musical instruments | 48,429 | 26,555 | 28,1[illegible]7 | 25,413 | 751,819 | [illegible]17,778 |
| Opium and extract of | 38,880 | 318,418 | ... | ... | 1,427,687 | 2,786,696 |
| Paints | 106,847 | 30,795 | 1,245 | 2,203 | 935,477 | 1,108,804 |
| Precious stones | 100,169 | 292,207 | ... | ... | 6,291,492 | 6,698,488 |
| Provisions, including vegetables | 1[illegible]8,632 | 29,850 | 1,917 | 14,097 | 677,9[illegible]8 | 1,511,446 |
| Salt | 230,710 | 196,998 | 153,771 | 107,247 | 517,215 | 1,837,432 |
| Seeds | 32,033 | 32,409 | 3,459 | 1,695 | 3,012,220 | 3,279,228 |
| Spices of all kinds | 214,521 | 68,790 | 3,105 | 13,182 | 2,[illegible]51,543 | 2,428,657 |
| Straw and palm leaf, and manufactures of | 41,213 | 38,561 | 35,766 | 2,343 | 3,768,216 | 3,947,002 |
| Tobacco and manufactures of | 13,291 | 3,177 | 394 | 258,321 | 6,577,920 | 7,392,300 |
| Watches, watch movements, etc | 17,467 | 7,704 | 1,914 | 4,2[illegible]0 | 1,493,880 | 1,520,948 |
| Wool, Goat's hair, etc., and manufactures of | 15,205,542 | 3,051,970 | 213,601 | 126,419 | 37,517,398 | 57,638,743 |
| Zinc, spelter, etc., and manufactures of | 21,707 | 53,951 | 2,010 | ... | 568,537 | 653,390 |
| Argols | 6,819 | 94,546 | ... | ... | 2,004,038 | 2,105,403 |
| All other articles, f. o. d. | ... | ... | ... | ... | ... | 11,080,486 |
| All other dutiable articles | ... | ... | ... | ... | ... | 8,224,122 |
| Totals | $68,716,380 | $35,978,084 | $19,966,523 | $11,073,155 | $627,253,643 | $760,989,056 |

value is credited to the depositor, less the commissions. The bars are mostly shipped to New York, and the bankers draw bills against them in favor of those who have remittances to make to the bank. The competition among the bankers reduces the rate at which these bills can be sold to a point that leaves apparently no profit, and it is charged in some cases that they draw at a loss, in the view of monopolizing the business. The refining leaves a small profit. The cost of shipping the gold to New York may be thus stated: freight, etc., $1.57; state stamp on bill, 20 cents; insurance, $1.50—making $3.27 on $100. But the insurer gets from the Mutual companies scrip, worth on an average 35 cts., which reduces the cost to $2.92. The bars sometimes command a higher price in New York than in San Francisco. Thus, a bar of 100 ounces, 880 fine, is at this moment worth *par* in San Francisco, and 900 fine is worth 87½ cts. premium in New York. This price has reference to the gold only of the bar. There is some silver in each. Thus, in the bar 880 fine there is 88 ounces of gold, 11½ of silver, and ½ oz. copper. In the other 90 oz. gold, 9½ silver, and a half copper. This makes the gold worth ½ per cent. more in New York than in San Francisco, and reduces the cost of the bill to $1.92 per cent. It is evident that he who sells his bills at 2 per cent., makes but 8-10 of 1 per cent., or, including other items, a small loss. If the house feels strong enough to insure itself, it saves the insurance; but this must be more or less a risk to those who take the bills. Thus the operation is one of mere cost of shipment of the gold; but the control of so much gold on paper issued is an object with large firms. The higher value of gold at New York arises from the fact that it is the financial center of the Union. The exchanges of the country with Europe and with the interior of the states turn there. The south ships its cotton, and tobacco, and rice; the west its produce; and the Atlantic states their manufactures. These, as we have seen, give an aggregate value of over $300,000,000 sent abroad in a year. The shippers of these goods draw bills against them, and offer them for sale. The market of sale must be where the greatest demand for remittance exists. New York imports five-sevenths of all the goods received into the country, consequently the demand is there the greatest for the bills, and they are sent there for sale. It happens that the great majority of bill-drawers are unknown to the buyers, hence there is hesitation in taking their bills. To obviate this, a number of large banking houses connected abroad, and having great capital, buy the bills that have "bills of lading" attached, and the goods are sent to their correspondents abroad. In the seasons of the year when shipments are most active, these bills are plenty and low. They are then purchased and endorsed, and sold with the endorsement at a higher rate when the season advances and the cotton bills run short. If the demand is active, and the rate of money higher here than abroad, the bankers draw on their own resources, and lend them the proceeds of the bills they sell on stocks or other securities. They are also the buyers of the gold bars as they arrive from California, and pay such rates as the demand for exchange, or the rate of money, or the price of gold on the continent, present or prospective, will warrant. A demand for silver to go to Asia, causes a demand for gold with which to buy it on the continent, and this demand draws upon New York, and indirectly upon the whole country. It is obvious that the bill business is thus mostly in the hands of large bankers. This grows out of the fact that there is abroad no market for bills on New York. Thus, the New York importer of goods, in order to pay for them, buys a bill on ships' specie, instead of ordering his creditor abroad to draw upon him, which would be done if a bill on New York were salable in the London market. It is understood, that when such amounts of bills from the south and elsewhere are sent to New York for sale, the proceeds of those sales form a large fund due by New York to those sections. These funds are deposited in the New York banks, and by them employed in loans upon stocks, or in such other ways as will pay an interest. Thus the whole country contributes to the supply of capital at that common center. The New York banks, some fifteen years since, in order to encourage that centralization, allowed interest of 4 per cent. on the funds so deposited. This caused a greater sum to be so employed, and imposed on the banks the necessity of lending it, in order to make a profit. The amount of funds lying in New York varies from $50,000,000 to $90,000,000, according to the season of the year. The banks in all sections of the country that have such funds in New York do not draw against it directly in favor of those who want to remit to New York, but they use the funds to buy up their own or other paper cheap. The effect is to swell the supply of funds in New York, and at times foster speculation there.

The funds that accumulate in New York make it also the mart for stock operations; and these are very large, as well for regular investments as for merely gambling operations.

With the creation of any commodity whatever, there springs up almost simultaneously a class of persons to deal in it, and to appropriate more or less capital to its prosecution. This capital is most generally applied to the purchasing of it when it is thought to be cheap, in order to hold it until it can be disposed of to better advantage, or in advancing money to the needy seller. The persons so engaged, by devoting their time and attention to the subject of their traffic, reduce it to science, and soon determine and classify the kinds and qualities adapted to the markets and wants of the public. The dealing in stocks is comparatively of modern origin, and commenced with the credit system of the European governments, at the close of the seventeenth century, when William of Orange avoided the dangers that beset the throne of the Stuarts, by borrowing money instead of extorting it by illegal taxation like Charles I., or stealing it like Charles II. The moment that government stocks—or certificates of debt issued to the government creditors—made their appearance, they became subjects of traffic, and with the certificates of stock in corporate companies, formed the material for speculation, and the exchange markets, where the surplus wealth of communities seek investment, became the theatre for operations in securities. The American colonies had no stock debts or corporate companies, since little surplus capital existed for such investments. The paper money that they issued, however, afforded by its fluctuation many opportunities of jobbing at the expense of the public. When the revolutionary war broke out, the continental money of the federal government gave a larger field for these operations, which were based mostly on the rapid depreciation of their value. Thus, a person would borrow a sum, returnable in the same description in a fixed time. Its value in that time having fallen, he could return it at a profit. Supposing the money to be par, a person would pledge a bag of $1,000 for paper; a fall of eight or ten per cent. in sixty days would enable him to redeem his dollars with $100 profit. In the time of the revolution, a stage driver, having a talent that way, made money in the traffic, and subsequently became the head of the largest bank and stock house of his time in New York, ending a long and respected life by suicide. This paper soon perished, and was succeeded by the government stock representing the public debt. This was soon accompanied by United States and other bank stock, insurance, canal, mining, railroad, etc., to an immense amount. Up to 1825 the majority of the stocks were banks and insurance, but there was no regular stock market. There were brokers who bought and sold stocks, but there was no concentration of operations. In that year the legislature of New York authorized the New York stock board, which has since continued to be the stock market. Within the last twenty years, boards of brokers have been started in most of our large cities. Their operations are, however, to a very great extent, based upon those of New York, with which they communicate by telegraph. The board of brokers sits with closed doors from 10 1-2 A. M. to 12 M.; an irregular session is held about 2 1-2 P. M. There is a president, a treasurer, and a secretary; the latter keeps a list of all the stocks dealt in in the market; the members are admitted by ballot after notice of nomination by one of the board. Each member must have been at least a year a broker, and on his admission pay a fee of from $1,000 to $5,000. Some of the boards or exchanges require even higher sums. When the members are assembled, the president proceeds to call the list, and as each stock is named in succession, those who have orders to buy or sell make their offers, and the transactions are recorded, when they become binding upon the members. If any of these default he loses his seat until he can pay or arrange the claim. The theory of the board is that it is the reservoir where all stocks held by the public are brought for sale, and where all buyers come, through brokers, to purchase. The number of brokers is over 1,200, and the commission charged is a quarter of one per cent., that is to say, $25 on $10,000. The board requires each member to charge not less than a quarter, but as most of them sell again for their customers for nothing, the charge is practically one-eighth.

The quantities of stocks to be dealt in have greatly increased of late years. They are so constantly changing, and their number increases at so rapid a ratio, that a statement which would be perfectly correct to-day, would be wide of the mark three months hence. There has been, moreover, a division of stocks into classes, most of which have now their special boards of exchange; thus there is a mining board dealing only in mining stocks and bonds, and bank and insurance boards, while the stock exchange confines itself almost exclusively to railroad stocks and bonds, governments, telegraph stocks and bonds, with rarely a few state bonds, bank stocks, and the best known coal and mining stocks. The amount of the transactions in stocks and bonds is enormous. Many of the transactions are private, and of a speculative character. Where they are *bona fide*, and a consideration passes between the parties, other than that of mere margins or differences, the result appears in the Clearing House operations. The magnitude of these astonishes even the wealthiest of European cities. The exchanges for a year in the New York Clearing House, have nearly equalled the entire true valuation of the country. Thus the exchanges and balances were in—

| | | |
|---|---|---|
| 1869, | $37.407.028,986.55 | $1,120,318,307 87 |
| 1870, | 27,804.539,405.75 | 1,036,484,821.79 |
| 1874, | 20.850.681.962.82 | 971.231,280 73 |
| 1876, | 19,874.815.369.61 | 1,009.532.037.19 |
| 1878, | 19.922.733.946.59 | 951.970,454.25 |
| 1880, | 37,182,128,621.09 | 1,516,538,631.29 |

In 1881 the exchanges exceeded forty billions.

The speculative transactions far exceed those of other kinds. The actual investments of capital are not large at the board. Those who take stocks for income do so of the issuers when the proposals are put out, and they hold them like the United States and state stocks, which rarely come on the stock exchange. The mass of the transactions then are of non-dividend paying stocks, that are the foot-ball of speculation, and so pay the operators profits. The brokers are mostly cliques of operators, who, when the market is dull and prices are low, combine, as "bulls," to purchase, producing a rapid rise, in the hope, seldom disappointed, that the speculative community will be tempted by that rise to come in and buy; as they do so the brokers unload themselves upon the buyers, and then become "bears," combining to depress the market, and to compel a fall at least equal to the rise, skinning the outsiders in the process. The speculators generally buy on time, that is, to pay for the stock at their option, any day within thirty or sixty as the case may be. In this way the buyer pays interest on the purchases. He may also sell to deliver at any day he pleases within a specified time, or "seller's option," or to deliver at the "buyer's option;" he may borrow stock and sell it in the hope of buying it back cheaper on delivery; he may buy a privilege to deliver a stock at a certain price at a specified time, or not, as it suits him; or he may sell or buy a privilege of taking and paying for a stock, or not, as it suits him; he may buy cash stock and sell on time. To produce a fall, cliques will sell for cash all the stock they have or can borrow, and then offer time contracts without limit, until other holders are frightened and sell. Confederates keeping up a clamor to alarm the public at such times, all offers to buy are smothered, and orders to purchase are suppressed. On the other hand a combination for a rise is accompanied by the most astonishing prophecies of a "good time." Considerable quantities are bought on time, the sellers hoping to get them cheaper. Meanwhile the cash stock is bought up and pledged for more money to repeat the operation; the demand for the stock bought on time runs up the rate, and the public are expected to come in with sufficient strength to let the clique all sell out at a profit, when they will be ready for a bear operation. There are numberless modes of varying and combining speculative operations, which would fill a volume. All these time operations were illegal until 1859, when they were all legalized, and a stock debt may now be collected like any other.

The amount of the transactions is immense. In 1840, the aggregate of sales for the month of June was $3,684,460; of this one-half was bank stock and one-half Delaware and Hudson canal. In June, 1857, previous to the panic, the sales reached $250,000,000, mostly railroad stocks. In 1871 the sales for May were considerably over $600,000,000. These transactions require a great deal of money to conduct them, and these funds come to New York to a considerable extent from neighboring cities as well as from the west. They also employ a large portion of the funds of the banks put out "at call," and also the proceeds of bills sold by large exchange houses. Thus we may suppose a house sells on the departure of a steamer $500,000 of sterling bills. This money is paid into bank, and is loaned out on stock securities at 7 per cent. on call, until, by a succeeding steamer it may be called in and remitted in gold to Europe. This operation, on a large scale, will induce the banks to call in their loans to protect their specie, and the value of money will rise in the market. The rule in stock speculation is loss, and the experience of the most fortunate dealers is that the interest and commissions absorb the whole average profits. The funds sent to New York, therefore, for stock-dealing, only contribute to the central profits.

The number of strangers that are drawn to the city in a year by ocean steamers is more than 500,000, and they fill the hotels that have of late taken such splendid proportions, and have been carried up to Forty-Second street, a distance of four miles from the old business center. The march of hotels up-town has been steady. The Astor House was, in 1833, the up-town house. From the Astor House to Chambers street was a long remove, in 1840. In 1852 the St. Nicholas advanced a mile to Spring street, and became not only the up-town, but the "upper-crust" of all hotels. In 1854, Niblo's Garden, on Prince street, was occupied by the Metropolitan ; and, soon following, the Everett House, taking ground a mile higher, opened on Sixteenth street ; and in 1859, superior in distance, size, magnificence, and expense, the Fifth Avenue Hotel opened on Twenty-Third street. The Southern, the Grand Central, the Hoffman, the St. James, Windsor, Brunswick, and a score of others have since been added, besides the family hotels, like the New York, St. Denis, Clarendon, St. Germain, Spingler, Sturtevant, Prescott, etc. Extravagance is only an allurement. Indeed, the hotel-keepers seem to have followed the advice of Boyden, when he first gave popularity to the Astor. His cracker-baker complained that the waiters were inattentive : "Kill me two of them, and put it in your bill," he briskly replied. And to his partner, who spoke of the exactions of guests, he replied, "Furnish a gold dust pudding, with diamond plums, if they require, but charge accordingly." That is the secret of hotel-keeping in New York—let nothing be wanting, not even a sufficient charge. Immense waste, no doubt, attends the system, but it attracts. The splendid arrangements tempt many city families to take up their abode in them; and a small family, even at $3.50 per day per head, do better than to pay the extravagant rents demanded for fashionable houses, with the attendant expenses. The numerous visitors to New York from the south and west, as well as the constant current of traders, better class of emigrants, and California passengers, fill the hotels of the lower parts of the city; and the whole mass, by their purchases for personal use, make an important part of the city retail trade, which has overflowed Broadway, and has sought Fourteenth street, Union Square, 20th, 21st, 22d, and 23d streets, and Sixth and Eighth avenues. The records of arrivals show the average number per day at all the hotels is not far from 5,000, or the immense number of 1,800,000 per annum. This, at an average of $3, gives $5,400,000 for hotel bills alone, but all the expenses cannot be estimated under $20,000,000. The facilities of railroads and ferries also induce a great deal of trade from surrounding cities and towns within a reasonable distance. Within an area of 75 miles there are few who do not do their shopping in New York, and very many of the small local shops send daily messages to the city to complete orders they may have received. On the other hand, a large quantity of manufactures that were formerly confined to the city are now sent long distances into the country, particularly in the winter, where they are made at less prices by those who are not dependent upon them for a living. The large circle of country thus loses its rural character, and partakes of the metropolitan nature. It follows that, as city localities become known for particular business, and visitors seek them to trade, all of that class of dealers seek business places there, and thus concentrate the business. The fixed population of the city is given by the census at 1,206,299, and, with the neighborhood more or less connected, the wants of 3,500,000 require to be met from the retail stores of the cities, in addition to the crowds of visitors from abroad. The retail trade is therefore a very important one, and its vigor, apart from the purchases of visitors, depends in some degree upon the cheapness of food. Where immigration has reached over 3,000 souls per day, composed of persons skilled in almost all employments, and all eager to obtain work, competing with those in the city who live by their occupation, and with those in the country, who are, so to speak, amateurs, it is evident the wages cannot be extravagant, and the amount that can be spared from them, after deducting house-rent and food, is not much in the average. Food is, however, the important item. When that is cheap, trade is more active. While cheap food is an important item in the ability to purchase, yet employment is the main consideration, and this depends upon the prosperity of those sources on which the city depends for its business. These in the long run are progressive, notwithstanding the reactions that sometimes take place, and the diffusion of employments which machine inventions tend to bring about.

The general prosperity of the whole country, does not, however, depend upon any locality: all production and all business is constantly seeking the conditions under which it can best thrive. These cannot be dictated; but, being found, the general welfare is as a consequence the greater, and with the general prosperity the common center must only become the more magnificent.

In this full account of the great commercial metropolis, we must not forget its sister city, Brooklyn, which, though long regarded as New York's bedroom and suburb, has within the past two decades blossomed into an independent city of more than 600,000 inhabitants. A very considerable proportion of the foreign commerce of New York comes to the wharves and piers of Brooklyn; most of the grain, provisions, etc., shipped, is first stored in its warehouses and loaded upon the outgoing vessels by its elevators. Its manufactories produced in 1880 over $190,000,000 of goods. It is the great center of the petroleum trade, and has the largest navy yard in the United States. It has borne two-thirds of the expense of the great suspension bridge over the East River, which is now nearly completed at a cost of $15,000,000. It maintains its rank as the third city in the United States, and is growing more rapidly than any other with the possible exception of Chicago.

We should not do full justice to this subject of the growth and commercial influence of our larger cities, if we failed to notice those cities of the interior and the far west which, mostly within the past ten or at farthest twenty years, have grown up to be centers of distribution and of accumulation of exports over a wide extent of territory.

These are of two classes. The Pacific ports and the large towns west of the Rocky Mountains which are tributary to them; and the interior cities which have no direct foreign commerce, but are yet largely engaged in interior commerce. To the first class belongs San Francisco, much the largest port on the Pacific coast and ranking in its foreign commerce the sixth of American cities. The following table gives the exports, imports, and total exports and imports of San Francisco for the years named:—

| Years. | Domestic and Foreign Exports and Specie. | Imports. | Total Imports and Exports. |
|---|---|---|---|
| 1860, | $10,296,016 | $9.577,921 | $19.873,937 |
| 1866, | 30.113,312 | 15,568,416 | 45.681,728 |
| 1870, | 35,976,324 | 21.834,103 | 57,810,427 |
| 1875, | 31.238.343 | 34,085,481 | 65,323,824 |
| 1880, | 40,358,902 | 41,265,317 | 81.624,219 |
| 1881, | 41,977,268 | 44,668,281 | 86,645,549 |

San Francisco has also large manufacturing industries, and is the headquarters of all the mining interests of California, Arizona, Nevada, Utah, Idaho, Oregon, and Washington Territory, and of some farther east, and has concentrated the fisheries and fish products, the lumber and timber trade, the wine-growing and grain trades of the Pacific coast. The population of San Francisco in 1880 was 233,959; in 1870, 149,473. Portland, Oregon, is an enterprising and rapidly growing city on the Willamette, a short distance above its junction with the Columbia. The largest steamers can come up to its wharves. Its exports in 1881 were $3,082,805 and its imports $610,187. It is an important distributing point for Oregon and Washington. Its population in 1881 was about 25,000. Oakland, the Brooklyn of San Francisco had a population of 34,555 in 1880, against 10,500 in 1870. It is receiving considerable commerce and internal commerce independent of San Francisco.

Sacramento, the capital of California, on the Sacramento river, has also a considerable internal commerce. It had in 1880 a population of 21,420 against 16,283 in 1870. Salt Lake City, the capital of Utah and of Mormondom, is a town of considerable importance as a distributing point for Utah, Idaho, Western Montana, and Eastern Nevada. It had a population of 20,768 in 1880 against 12,854 in 1870.

The interior cities which are concentrating the travel and the receipt and distribution of produce and goods over wide sections of country are more numerous; many of them are of recent growth, others are older but have only recently attained a prominent position. We can only give their names and population with occasionally a word respecting their specialties. Columbus, population 51,647 in 1880; Toledo, an active lake port, population 50,137; and Dayton, a great railroad center, population 38,678, are the leading cities of Ohio after Cincinnati and Cleveland. Indianapolis, a large manufacturing city with 75,056 inhabitants, Fort Wayne with 26,880, Evansville with 29,280, and Terra Haute with 26,042, are the principal towns of Indiana.

Illinois has no very large towns except Chicago, Peoria, with some manufactories and many railroads, population 29,259. Quincy, also a railroad city, with 27,268 inhabitants, and Springfield, the capital, with 19,743, are the most important towns, but are not distributing points of much importance.

Michigan has besides Detroit only Grand Rapids with 32,016, Bay City with 20,693, and the two Saginaws. Saginaw City and East Saginaw, with about 25,000 inhabitants between them, and in the heart of the great lumber and salt region. Crossing the lake, Milwaukee, of which we have already spoken incidentally (population, 115,587), contends manfully with Chicago for the supremacy in the grain trade. The city has also a large lake trade and extensive manufactures. Iowa has no large cities, and for the most part only a local trade. DesMoines, Dubuque, and Davenport have each a population of about 22 or 23,000. In Minnesota we find two wide awake cities, Minneapolis and St. Paul, one largely engaged in the flour trade, the other in other manufactures, and both bidding high for the trade of Dakota, Manitoba, and Maritoba. Minneapolis had in 1880, 46,887 inhabitants, and claims 60,000 now, and St. Paul with 41,473 in 1880, is content with nothing short of 55,000 now.

Omaha in Nebraska, long the terminus of the Union Pacific, with large machine shops, smelting works, and manufactories, and a population of 30,518, is a city of considerable importance, but St. Joseph, Mo., with 32,431 inhabitants, has of late years passed it in the race, to be itself in turn passed by Kansas City, the most wide awake city west of St. Louis. Kansas City had 55,785 inhabitants in 1880 against 32,260 in 1870. It is the center of a network of railroads radiating in all directions, and is growing very rapidly. Its assessed valuation (at less than 50 per cent. of the true) was $13,378,950 in 1880. Its grain receipts average over 10,000,000 bushels, number of hogs received 676,477; number packed 539,097; cattle received 244,709. Denver, Colorado, is the latest addition to the distributing points in the west, and is making very rapid progress. Its population in 1880 was 35,629, against 4,759 in 1870. It claims 50,000 now. The young city has not only all the appliances of the highest civilization in its schools, churches, gas and waterworks, drainage, etc., but has numerous manufactories and smelting works, and a very large jobbing trade over an extensive section.

Leadville in the same State is the center of the great mining region; it has a population with its immediate suburbs of 30,000, but is too high up in the mountains to become a point of distribution for anything except mining stocks. Santa Fe, New Mexico, is an old trading post and is trying to maintain its position, but finds it hard to shake off its old Spanish dignity and slowness, and may yet be passed by some of the newer towns. Tucson, Arizona, is likely to be a railroad center, and may gather the trade of Arizona, but the heat of the climate is against it.

Galveston (population 22,248), San Antonio (population 20,550), Dallas (nearly 20,000), Houston (about the same), and Laredo, the new and growing city on the Rio Grande, with 8,000 or 10,000, are the principal distributing points in Texas.

Little Rock in Arkansas, Memphis and Nashville in Tennessee (populations respectively 33,592 and 43,350), are the centers of trade in these two states, as Mobile (population 29,132), and Montgomery, are for Alabama and Mississippi.

The Eastern cities though very numerous and populous, are mostly tributary to the great cities, and supply only local districts of no great extent. Their wealth and populousness are generally due to manufactures or to some specialty of trade.

# BANKS IN THE UNITED STATES.

## CHAPTER I.

### BILLS OF CREDIT—GOVERNMENT ISSUES—UNITED STATES BANK.

The use of paper money is a modern invention, and may yet be considered but as an experiment, since, from its first emission in the colonies to the present day, paper money has constantly changed its form and the conditions of its circulation. It is not to be inferred that paper money originated on this continent, since it was used long before in the countries of Europe. Its nature has, however, been more developed here, and every phase of it has had full scope of action. The circulating paper is of many forms, such as bills of exchange, promissory notes, government bonds bearing interest, government bonds bearing no interest and not convertible into coin, but receivable for taxes and dues, and lastly, corporation or bank promises to pay coin on demand. There are many other descriptions of circulating paper, but these are the chief that are used. The last two are those which have figured most as money. The intention of paper money is to supply the place of coin where that article is not sufficiently abundant, as was eminently the case with the early colonies. The colonies were none of them rich, and had not been able to import and keep as much of the precious metals as would serve for a currency, that being as much an instrument of commerce as a road or a ship. In substituting paper for coin there is no difficulty as long as the quantity emitted does not exceed the demands of business for a currency. If there is no trade—that is, if no one wants to exchange his commodities for others—there is no want of currency. As the desire to trade increases, a want of money to represent commodities is experienced, and the want is proportioned to the numbers, wealth, and activity of the traders up to a certain point; because when trade is very active, money itself changes hands rapidly and performs more transfers than when it is sluggish. There must be, however, great confidence in the value of the money, because doubt in that respect instantly checks traffic. The early colonists were in that position. They had commodities which they had raised and made, but they had no currency, or not enough. In this position, in 1690, it became necessary for Massachusetts to send a military expedition to Quebec to drive the French out of Canada. The expedition failed, and the troops came back clamorous for pay. The colony had no money to pay with, and it adopted the expedient of issuing promises in convenient amounts. The faith of the colony was pledged for the payment of these, and they would be received for taxes and dues. It will be observed, that these bore no interest, and were not convertible into coin. They were, in fact, mere orders of the government upon farmers and others for food, clothing, etc., in favor of the soldiers, to be called in by taxes, not to be paid in money. The paper was worth nothing to export. Its only value consisted in its being good to pay taxes with. It is at once obvious that no man wanted more than would suffice for that purpose. The aggregate amount that could be issued was then measured by the sum of the taxes. In order to increase the amount, the colonial government made it a legal tender, that is, compelled creditors to take it for private debts. This was so palpably unjust, and was productive of so many evils, that the home government suppressed it. Nevertheless, the same necessities produced similar devices, and other colonies followed the example of Massachusetts with similar results.

In 1745, Massachusetts, to defray the expense of an expedition to Louisburg, again issued bills of credit to the extent of £3,000,000. This paper speedily depreciated to 11 for 1: that is, £1 in silver was worth £11 in those bills. The English government then sent out £180,000 in silver, to pay the cost of the expedition, and with this the thrifty colony bought up its own paper at 11 for 1. New York, during the period 1709 to 1786, made thirty-four issues of bills of credit, amounting in the aggregate to £1,563,407, and the depreciation was about 2 to 1; in other colonies much more. The evils attending these issues were very great, but the cause continued to operate, and when the war commenced in 1775, the Congress of the Confederation was forced upon the issue of $3,000,000 worth of "continental money," as distinguished from the state issues; and to give these issues some firmness, they made them a legal tender. This supply of paper, in addition to the colonial emissions, increased the difficulties, and some of the colonies went a step further and made *personal property* a legal tender, according to appraisals to be made for the purpose. Notwithstanding the general discredit, Congress was obliged to push the issues. In 1779 the amount outstanding was $160,000,000, and by 1780 it reached $200,000,000, when the value fell so fast that before the end of the year the bills ceased to circulate. There are those still living whose parents had, between 1780 and 1800, given $100 for "a cake of gingerbread," or $10,000 for a hat cocked in the fashion of the day. The whole amount issued by Congress was $359,456,000, and on the formation of the new government they were purchased at the rate of 1 cent for $1. The state issues met with similar fate. The entire absence of money, with its attendant evils, mainly induced the adoption of the federal constitution, which prohibited the states from ever again issuing "bills of credit," or making "anything but gold and silver a tender for the payment of debts." These prohibitions are a record of the experience derived from the colonial experiments in paper money.

The condemnation of "bills of credit" was a great good. The important question was, however, what to do next; and this engaged all minds. Specie had vanished, and government paper money was dead. Mercantile sagacity had, however, on the death of the continental money, devised a partial remedy in 1781. This consisted of the substitution of private corporate credit in place of government credit, and took shape in the chartering of the Bank of North America, at Philadelphia; the Bank of New York, in the city of New York; and the Bank of Massachusetts, in Boston.

It is an erroneous idea, that was entertained for a long time, that banks, by the issues of credit, create capital, and on this idea many new banks were started, imparting much activity to trade. The good effects of their operation were due, however, rather to the concentration and application of capital to mercantile uses, than to an increase in the quantity of capital. Before the establishment of banks, individuals kept the money they received in their own houses, tempting robberies, and subjecting themselves to loss of interest, and to risk and trouble in seeking small investments. The shopkeeper and merchant who received money in the course of business in small sums, kept it by him until he made his wholesale purchases, when he paid it out altogether. The aggregate sum thus lying entirely idle was very large. On the establishment of a bank, the owners of money deposited it in the vaults. The institution thus became the common receptacle for all idle funds. Inasmuch as that, although all the depositors were entitled to draw their money whenever they chose, yet but a small proportion did so, the banks might safely lend the money so deposited on notes at short dates, sixty to ninety days, and still have as much within their control as would meet the probable demand of the depositors for payment. It was necessary, however, that the notes discounted should be promptly paid at maturity, in order that the bank, itself subject to be called upon to pay on demand, might have control of the means of payment. The discount of mercantile notes with two good endorsers then became the business of banks; and we may here remark in passing, that this wrought a change in the mode of borrowing money in the community. Up to that period, good character, industry, and sobriety were security for loans. An illustration of this is afforded in a bequest of Dr. Franklin in trust to the city (then town) of Boston, of a sum of money from which young mechanics of the above characteristics were to be loaned two hundred dollars to start them in business. They were to repay the money with interest, and the sum, with its accumulation, was to continue a fund for the same purpose. The fund still continues to exist, but without accumulation. Under the newly established banking system, character was no longer an element of credit. A note with two good names became indispensable. The capitals of the banks were seldom paid in loanable money. They were notes of the subscribers, or deeds and mortgages of real estate, and were mostly designed to inspire confidence. A portion of the capital was necessarily kept on hand in specie to meet the calls of depositors and note-holders. The banks, in order to increase their loanable funds, issued their own promises to pay specie on demand, they to circulate as money. The old colonial issues of credit bills did not pretend to be payable on demand, and the application of that principle, it was now supposed, would obviate the evils that had grown out of the old system. The bills were freely taken and circulated. The institutions were not limited in the amount that they might issue, and they increased the currency almost at pleasure. It became obvious, however, that if one bank issued a larger quantity in proportion than the other banks, its notes, paid into the rival institutions, would immediately be sent back to it for redemption, and it would have to pay in specie the balance above what it held of their notes. Hence the laws of trade compelled each bank to keep its credits within a safe ratio to those of other institutions. This, however, did not prevent all from increasing their issues to any extent as long as their mutual balances were adjusted. When, however, the whole of them increased their circulation, the mass of currency became cheap, a fact which manifests itself in a rise in prices of all commodities. The effect of this is, that the produce of the country ceases to be exported, because it is too high to pay a profit to the merchant, while, on the other hand, goods are imported to avail of the high prices. This state of affairs involves an export of specie, which drains the banks, and forces back upon them their bills for redemption. Hence, if the banks regulate each other by their balances, the foreign trade becomes the common regulator of all. Kept within a certain limit, governed by produce and business, the bank circulation is useful. Although it does not in any degree create capital, it supplies the place of the precious metals as currency. If we suppose a miller wishes to purchase grain; he gets a note or acceptance at sixty days, on New York, discounted at a local bank, which pays out to him circulating notes. With these he purchases wheat of the farmer, flours it, and forwards it to New York for sale, and the proceeds are applied to the taking up of his draft that the bank had discounted. In the mean time the farmer has paid away the notes he took for his wheat, probably to the storekeeper in discharge of his bill. The storekeeper has now to remit to New York to pay a note that falls due for merchandise previously purchased, and furnished to the farmer. To do so he goes to the bank, and buys of it the draft on New York that the institution had discounted for the miller. This he remits to his merchant, who gets it paid from the proceeds of the flour. The transaction is thus closed, and by it farm produce has been got to market, and merchandise, in return, has passed from the manufacturer to the consumer, effecting an exchange of commodities without the use of any money at all. The notes that the bank put out on a draft, after performing the functions of money, returned to it in exchange for the draft, and all obligations were cancelled. This is the operation of paper when confined to actual business transactions. The number and kinds of these are almost infinite, but the principle is the same when the paper is only issued on actual commodities, the exchange of which cancels the obligations that grow out of them. There is, in this, no creation of capital, only the facilitating the exchange of that already created. Under such circumstances, the quantity of currency rises and falls with the quantities of produce and merchandise. The moment the bank lends its notes to speculative operators, who seek to borrow capital itself, rather than credits with which to interchange capital, it becomes insolvent, because it lends what it has not got to spare. The early banks mostly confined themselves to sound rules, and with the rapid increase of business which followed the formation of the new government, their business being profitable, stimulated the increase of institutions, mostly in New England, where commerce was concentrated. The three original state banks were eminently successful, and they suggested a resource to the federal government. This was developed in the celebrated report of Alexander Hamilton, Secretary of the Treasury, in favor of a National Bank. The proposition at once called up the right of Congress to charter a bank under the constitution. After a warm congressional debate upon the subject, President Washington demanded written opinions of his four cabinet officers. The Attorney General and the Secretary of State declared the bank unconstitutional. The Secretary of War and the Secretary of the Treasury were of a contrary opinion, and the celebrated paper of the latter upon the subject decided Washington, who signed the bill, and the bank went into operation with a capital of $10,000,000, of which $2,000,000 was subscribed by the government, and $8,000,000 by individuals. Of this latter amount, $2,000,000 was to be paid in specie and $6,000,000 in six per cent. stock of the United States. The charter was to continue until March 4, 1811. Immediately on the organization of the bank, the shares rose 25 to 45 per cent. premium, and the institution paid 8 1-2 per cent. dividend. The creation of this bank was attended by the rapid multiplication of banks in the various states, becoming rivals to each other, and gradually consolidating an interest which was strong enough in 1811, with other interests, to defeat the recharter of the Bank of the United States. The recharter was opposed on the grounds: 1st, that it was unconstitutional; 2d, that too much of its stock was owned by foreigners; 3d, that state banks were better. It is singular that at a time when capital was scarce in the country, objections should have been made to its coming in from abroad. Nevertheless, the bank was closed, and on settlement paid $108 1-2 to each share of $100. From that date, gold and silver only were by law receivable for government dues. The winding up of the National Bank was the signal for creating state banks to fill the vacuum. The old bank and its business was purchased by Stephen Girard, who conducted with it a large private banking business with great success on a capital of $1,000,000. In four years, to 1815, 120 banks, with an aggregate capital of $40,000,000, went into operation. Pennsylvania alone, by act of March 21, 1814, created 41 banks. The amount of notes emitted by these institutions was never known with certainty, but was estimated by Mr. Jefferson, in 1814, as high as $200,000,000. A large portion of these, in the middle states, were issued as loans to the government; and the war pressure became such, that in September, 1814, all the banks out of New England stopped payment. The bills immediately depreciated 20 per cent. in Baltimore, and 15 per cent. in New York. The news of peace, in February 1815, caused some improvement, but in 1816 the difficulties were greater than ever. The discount in Baltimore was 20 per cent., Philadelphia 17, New York 12 1-2. This kind of paper being the only currency, the government was compelled to take it for dues, in violation of law. This caused the greatest injustice, since the funds received in one place were more depreciated than in another, and New England, where the currency was sound, had great cause of complaint. In such a state of affairs, although the state banks had multiplied to 246, with $89,822,422 capital, a new National Bank became inevitable, and Congress, by act of April, 1816, again chartered a National Bank, which went into operation January 1817. Its charter was to last until March 4, 1836; its capital was $35,000,000, of which the United States subscribed $7,000,000 in a 5 per cent. stock, and the remaining $28,000,000 was to be subscribed by individuals—one-fourth in gold and silver and three-fourths in the funded debt of the United States. The debts of the bank, in excess of its deposits, were not to exceed $35,000,000. The bank was to pay a bonus of $1,500,000, and perform the money business of the government free of charge. In return it received the public funds on deposit, and nothing was to be taken for public dues except specie, treasury notes, notes of specie paying banks, and the National Bank notes. When the bank went into operation it became necessary for the state banks to resume or wind up. Those of New York, Philadelphia, Baltimore, and Virginia resumed, and those which did not were gradually purged off. From 1811 to 1830, 165 banks, with a capital of $30,000,000, closed business. The loss of the government by these was estimated at $1,390,707, and the public lost much larger sums. The bank, in the first few years of its operation, encountered many perils, growing out of the foreign trade. Imports poured into the country in prodigious amounts, and an active demand for silver sprung up for Europe and Asia. The institution had, however, in the public stock and in its own stock, forming its capital, the means of drawing specie from Europe, which it did to an extent that subjected it to a loss of over half a million dollars.

The institution was of much service to the government, and enjoyed great facilities from the use of the public funds. The principal bank was at Philadelphia, with branches in most of the large cities. This organization of the bank made it very powerful as a means of exchange, and this power was likely to grow with the increasing wealth of the country, up to the time when railroads and telegraphs made communication more rapid. The power of the bank was based upon the federal finances, of which it was the agent, and it operated through the growing business of the country, which was conducted largely upon the credit system. As the country increased in prosperity, other banks, under state charters, sprung up, and these became the recipients of mercantile deposits, or, in other words, of the money which each merchant received in the course of his business, and also of private funds. The merchants who thus placed their funds with the banks were constantly debtors of the government for duties and taxes; these they paid by checks on their respective banks. The United States Bank, being the common recipient of all these checks, was thus always the creditor of the local banks, and could always force them to contract their loans by compelling them to pay, or could permit them to increase their loans by being indulgent in regard to balances. The government funds thus collected by the United States Bank were paid out by it wherever the government required. Thus the Boston and New York branches would collect the largest amounts, but the branches in Richmond and elsewhere, or the parent bank in Philadelphia, would pay the drafts of the government. In the first year of the old bank it received $3,652,000 of the public money. As business prospered, the amount rose annually, until it reached $17,038,859 in 1808, before the embargo. Thus the receipts and payments on government account were thirty-four millions in a year, when the whole population was 5,200,000 souls. The new bank in 1817 received $32,786,662 for accounts of the government. The sum declined year by year to $21,347,000 in the year of crisis, 1825, and subsequently continued at about twenty-four millions per annum, until 1833, when the deposits were removed by the government. These large sums annually flowed in and flowed out of the bank on account of the government, and a large proportion of the payments were on account of the public debt. This reached $127,334,934 in 1816, and was by annual payments extinguished in 1835, a period of nineteen years; the average amount paid off annually by the government was thus $6,700,000. The government bank, being furnished with such machinery, was necessarily the best medium of collecting bills; thus the New York merchants, as an instance, sold their goods to the shopkeepers all over the Union, and they took notes payable at the local banks. The credits thus granted could be collected by the United States Bank cheaper than by any other bank. Hence, in New York, the "branch" would be the receptacle for accounts to be collected in all other cities; the bank would forward these to its appropriate branch, say Richmond; the branch there would notify the local merchants of the notes it held against them; these would pay in checks upon the local banks where they kept their deposits, and all these checks collected by the United States branch would make it the common creditor of all the local banks, whose specie it thus controlled; it would notify the New York branch of what collections had been made, and these would credit the mercantile owners with the amounts. The power of the bank from this source, operating through all its branches, was much greater than from the use of the government funds, and the state banks complained loudly of the tyranny that they alleged it exerted over them. A stormy opposition was thus formed against it, while, on the other hand, a generation of merchants had grown up under its administration of the exchanges, and they feared the results of a change. Meanwhile, the question became political, and a great party, as early as 1829, gave indication that the recharter in 1836 would not be granted. A struggle between the bank and the government ensued, and in 1833 the President removed the public deposits from the bank and placed them with numerous state banks. These ran a race of expansion with the United States Bank; the consequence was an immense speculation, which resulted in general bankruptcy in 1837. The government, on removing the deposits to the state banks, enjoined them to be liberal to the merchants. This was done in the view of counteracting the stringency which the closing up of the United States Bank was expected to cause. This did not occur, however, since that institution also was liberal with its loans. A rapid expansion resulted from this rivalry, and speculation ran wild, particularly in public lands. In the midst of this excitement, the government issued the famous "specie circular," by which the lands were to be sold for cash, gold and silver only. The effect of this would be either to kill the speculation or to drain all the specie into the land offices;

it did the former. This was followed by a resolution of the Bank of England to cut off credits to American merchants, and the revulsion was precipitated. The charter of the United States Bank was not renewed by Congress, but the same institution obtained a charter from the State of Pennsylvania, February 18, 1836, under the name of the United States Bank of Philadelphia. The terms of this charter were very onerous, such as no institution could pay from profits; the bank consequently failed, in common with all others in the Union, in 1837. It resumed its payments, following those of New York, January, 1839, and struggled on until October 1839, when it finally failed. On going into liquidation, it was found that more than the whole of its large capital, $35,000,000, had been swallowed up, subjecting the stockholders to a total loss. This disaster was no doubt brought about by its abandonment of sound principles in the vain hope of compelling the government to recharter it. But the institution had outlived its usefulness; the country had outgrown the circumstances for which such a bank was fitted. We have thus sketched the outline of that bank before glancing at the progress of the state institutions, because, up to 1840, that bank was the controlling power. The progress of banking among the states has been step by step with the growing wealth, population, and commerce of the country. This growth was manifestly too vigorous to permit of the continued existence of any regulating power.

The relative growth of the state banks, and the business of the country proportional to the national bank, was as follows:—

| | No. | State banks. Capital. | National bank. Capital |
|---|---|---|---|
| 1791, | 3 | 2,000,000 | 10,000,000 |
| 1811, | 89 | 52,601,601 | 10,000,000 |
| 1817, | 246 | 89,822,422 | 35,000,000 |
| 1837, | 634 | 290,772,091 | 35,000,000 |
| 1860, | 1,562 | 421,880,095 | |

Thus the national bank, which began with a capital five times as large as all the state banks, was only one-fifth of their aggregate in 1811. In 1817 the state capital was two and a half times the new National Bank capital, and in 1836 it was eight times that capital. Had it then been rechartered, with the same amount, it would now have been but one-twelfth of the capital of the state banks.

## CHAPTER II.

### STATE BANKS—SUFFOLK SYSTEM—SAFETY FUNDS—FREE BANKS.

The growth of state banks has fluctuated from time to time, under different circumstances of local trade, and the general nature of banks has changed in obedience to similar conditions. The nature of the banking systems of each locality has, however, undergone repeated modifications, and the general tendency is to the circulation of less paper. We shall endeavor to give a sketch of each. The first attempt at banking in New England was the creation of a land bank in 1740. At that time about eight hundred persons subscribed a capital in real estate, and having appointed ten directors, agreed to issue one hundred and fifty thousand pounds in paper, to circulate as money. This was dissolved by Parliament, and the stockholders held individually liable for the bills. In 1784 a bank was chartered by the Massachusetts Legislature, and the other New England states followed the example from time to time. In 1805 there were in existence forty-seven banks in the six New England states, with an aggregate capital of $13,-353,000. In 1815, at the close of the war, these had risen to sixty-three banks, and $19,053,902 of capital, and the circulation had become large. In 1860 the number of banks in those states had risen to five hundred and five, with a capital of $90,186,990. In the course of this increase, the system of banking there had undergone less changes than in other states.

The paper currency of New England was generally of small denominations, and emitted by a larger number of banks with small capitals than that of most other sections. These institutions were scattered over the six New England states, and the bills of each bank forming the currency of its neighborhood, would, in the course of trade, ultimately find their way to Boston, the common centre of business. There being no provision for their redemption, they circulated at a discount, and this discount was increased in proportion to the issues of each bank, inflicting loss upon the community. To remedy this, the Suffolk Bank of Boston, in 1825, undertook to receive all the bills and send them home by an agent to the issuing bank, requiring each to redeem in specie at its own counter. This compelled each bank to keep a large amount of specie on hand, at an expense which ate up the profits of the circulation. They all agreed, in consequence, to keep at the Suffolk about three thousand dollars deposited, to redeem any balance of notes that might be there found against them. To keep down that balance each was then compelled to restrict its circulation to the actual business wants of its locality, that there might be no surplus currency; in other words, that the course of trade might carry to Boston no more of its bills than would be paid by the produce of the locality sent thither for sale, and also to send promptly to the Suffolk any bills of other banks that might come into its hands, as an offset to its own balances. Thus all the banks in New England were actively engaged in running each other, and five hundred streams poured country money daily into the Suffolk receptacle, to be assorted and sent back to the issuers. This kept down the volume of the currency in that section. After the creation of railroads and telegraphs, the difficulty of keeping out an excess of circulation was greater. To be "thrown out of the Suffolk," or, in other words, not be able to meet a balance there, was fatal to the reputation of a bank. The system worked well up to the civil war. It was the case, however, that although those institutions could not put out an excessive circulation in New England, many of them lent their notes on securities, on condition that the notes should be paid out at the far west, whence they would be very slow in returning for redemption. The Suffolk mode of regulation by the laws of trade was, upon the whole, very successful.

In New York the same evils manifested themselves as in New England, and in 1829 a remedy was attempted in the shape of the "safety fund." This did not undertake to restrain the issues of the banks, but to protect the public from loss by failure. Under it all the banks doing business in the state were required to contribute one-half of one per cent of their aggregate circulation to a fund to be called the "Safety Fund," out of which the notes of a broken bank were to be paid in full. This worked very well during a number of years of prosperity, but in the revulsion of 1837 a number of banks failed under disastrous circumstances, and the fund was found to be entirely insufficient—besides being wrong in principle, since it called upon the honest and well-conducted banks to pay the debts of the dishonest ones. It is hardly worth while, in a short history like this, to enumerate all the restrictions as to discounts, specie on hand, and emission of bills, that the various states have incorporated in bank laws. It may suffice to say, that all are powerless to prevent evil. On the failure of the safety fund system of New York, however, a radical change took place in the policy in regard to banks. The privilege of issuing notes to circulate as money at their own will and pleasure, had been found to be dangerous to the public, and the law of April, 1838, called the "free banking law," was passed, by which the power to issue bills directly was taken from the banks. Under that law, the Comptroller of the state prepared the plates, and delivered the bills to the banks, upon their lodging with him such securities, mostly state stocks, as amply secured the redemption of the bills. The name, "free banking," was given to the law, because it removed from the banks the restrictions relative to discounts, and the necessity for a charter. This law was altered in some respects almost every year of its existence, but its main features remained the same, and it became in New York the sole law to regulate banking. All the old banks, as their charters expired, reorganized under it, since the state constitution provided that no new charters could be granted or old ones renewed. The working of this law was so efficient and popular, that it spread into most of the northern and western states. The progress of banking in New York has been as follows:

NUMBER OF BANKS AND AGGREGATE CAPITAL.

| | No. | Capital. | |
|---|---|---|---|
| 1801, | 5 | 4,720,000 | |
| 1811, | 8 | 7,522,760 | Expiration of first U. S. bank. |
| 1816, | 27 | 18,766,756 | Recharter U. S. bank. |
| 1836, | 86 | 31,281,461 | Charter U. S. Bk expired; susp. |
| 1838, | 94 | 36,401,460 | Free banking law; resumption. |
| 1857, | 294 | 107,449,143 | Suspenion. |
| 1860, | 303 | 111,441,370 | Recovery. |
| 1861, | 302 | 109,982,324 | War commenced. |
| 1863, | 309 | 109,258,147 | Organization of Nat. banks. |

The New York law requires the banks to issue the bills at the place of their location, and to redeem them at not more than one-half per cent. discount in the city of New York. These institutions, however, have an arrangement with the Metropolitan Bank, in New York, by which they are redeemed at a less rate.

Pennsylvania, in the early part of the century, was slow to create banks, and it had but three up to 1814, in which year 41 new banks were incorporated. Subsequently, it created numbers, and has probably suffered more than any other state from its abused bank credits. The progress of affairs there was as follows, exclusive of the United States Bank, which was situated at Philadelphia:—

| | No. | Capital. | |
|---|---|---|---|
| 1801, | 2 | 5,000,000 | |
| 1811, | 4 | 6,153,000 | Expiration of U. S. bank. |
| 1815, | 42 | 15,068,000 | Low credit ; 41 new banks. |
| 1820, | 35 | 14,681,000 | Twenty-two banks failed. |
| 1836, | 49 | 23,750,333 | State charter U. S. bk ; susp. |
| 1839, | 49 | 25,255,783 | Resumption. |
| 1859, | 87 | 24,565,805 | Recovery from panic of 1857. |
| 1861, | 89 | 25,843.215 | War commenced. |
| 1863, | 94 | 26,561,357 | Organization Nat. banks. |

There was, up to 1830, a great number of unauthorized banks doing business in Pennsylvania, and they presented a constant succession of bankruptcies. The authorized capital down to the present time has not kept pace with that of other states, taking the wealth and population of Pennsylvania into consideration.

Maryland chartered its first bank in 1790, the Bank of Maryland, capital $300,000, and continued to increase them moderately up to the present time. The progress of capital there has been as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1801, | 2 | $1,600,000 | |
| 1811, | 6 | 4,835,402 | U. S. Bank expired. |
| 1814, | 17 | 7,882,000 | Banks suspended. |
| 1820, | 14 | 6,708,180 | |
| 1837, | 21 | 10,438,655 | Suspension. |
| 1859, | 32 | 12,560,635 | |
| 1862, | 33 | 12,505,559 | War in progress. |

New Jersey has been influenced to some extent in her banking operations, by the state of things in New York and Pennsylvania, and in 1850 it adopted the general banking law of New York. Its progress has been as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1805, | 2 | $1,000,000 | |
| 1811, | 3 | 789,740 | U. S. Bank expired. |
| 1815, | 11 | 2,121,933 | Suspension. |
| 1820, | 14 | 2,130,949 | |
| 1837, | 25 | 3,970,090 | Suspension. |
| 1850, | 24 | 3,565,283 | Free law. |
| 1855, | 32 | 5,314,885 | |
| 1857, | 48 | 7,494,012 | Suspension. |
| 1859, | 46 | 7,356,122 | |
| 1862, | 51 | 7,933,933 | War in progress. |

The multiplication of banks in New Jersey under the new law, was mostly for the benefit of circulating their issues in New York at a discount, and they were of but little service to New Jersey.

Delaware has created banks in proportion to its size, in the following ratio :—

| | No. | Capital. | |
|---|---|---|---|
| 1801, | 1 | $110,000 | |
| 1815, | 5 | 966,000 | Suspension. |
| 1819, | 6 | 974,000 | |
| 1837, | 4 | 817,775 | Suspension. |
| 1849, | 2 | 210,000 | Gold discovery. |
| 1859, | 12 | 1,638,185 | |
| 1862, | 14 | 1,915,010 | War in progress. |

Ohio has been, of all the states, the most diversified in its policy in regard to banks. Its first bank was chartered in 1803, but it did not increase charters much until migration set thither after the war of 1812, when the new United States Bank established two branches, one in Cincinnati and one in Chillicothe. The progress of banks was then rapid up to the explosion of 1837, when about 36 of the banks of that state failed, under disastrous circumstances, leaving but few in existence on the resumption of specie payments in 1840. In 1845, a new system of banking was introduced, designed to restore that confidence in banks which had been so rudely shaken by the previous failures. It was called the "safety fund system," being composed of thirty-six banks which, together, form the State Bank, under a board of control, composed of delegates from each bank, which furnishes the notes to all for circulation. Each bank must deposit with the board 10 per cent. of its circulation in securities. Of 42 banks started under this law, 36 remained with capital of $4,034,525. The same law created the "independent system," by which the banks doing business under it must deposit Ohio or United States stock with the State Treasurer to secure the circulation. There were 7 of these banks. There remained the old chartered banks, of which the Ohio Life and Trust—whose explosion in 1857 precipitated the panic which had been prepared for the public mind—was the last. In 1851, the free banking law of New York was adopted ; under this 13 banks were started. In the same year, by the new constitution of the state, the legislature was deprived of the right to grant banking powers until the law for so doing should be approved by the people. The general progress in Ohio to 1862, was as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1805, | 1 | $200,000 | |
| 1811, | 4 | 895,000 | |
| 1816, | 21 | 2,061,927 | New U. S. Bank. |
| 1837, | 32 | 10,870,089 | Suspension. |
| 1845, | 8 | 2,171,807 | State bank law. |
| 1851, | 56 | 7,129,227 | Free law. |
| 1854, | 66 | 7,166,581 | Free law. |
| 1859, | 53 | 6,701,151 | Recovery. |
| 1862, | 56 | 5,539,950 | War in progress. |

Indiana became a state in 1816, and in 1819 there were two banks, with a capital of $202,857, and so continued until 1834, when the State Bank of Indiana was created, capital $1,600,000, and with ten branches, which were mutually liable for each other's debts, and notes under $5 were prohibited. The bank stopped, partially, in 1837, and resumed payment October, 1841. In 1852 the general banking law of New York was adopted, and under it ninety-four banks were speedily organized, and fifty-one of them soon failed. The charter of the State Bank of Indiana having expired, the legislature chartered a new one, with capital of $6,000,000, and twenty branches, which bought out the state interest in the old bank, the charter being paid up to January 1, 1857. The progress of the state has been as follows·

| | No. | Capital. | |
|---|---|---|---|
| 1819, | 2 | $202,857 | |
| 1835, | 10 | 800,000 | State bank. |
| 1837, | 11 | 1,845,000 | Suspension. |
| 1839, | 11 | 2,216,700 | Resumption. |
| 1841, | 11 | | |
| 1852, | 44 | 5,554,552 | Free banking law. |
| 1854, | 59 | 7,281,934 | New state bank. |
| 1859, | 37 | 3,617,629 | |
| 1862, | 39 | 4,557,654 | War in progress. |

Eighteen of these free banks, capital $1,203,454.

Illinois came into the Union in 1818, and in 1819 there were two banks, capital $140,910—one of which had been chartered in 1813, under the territory. It stopped in 1815 and remained so until 1835, when the legislature revived it and increased its capital to $1,400,000. The constitution of the state in 1818 forbade the creation of any new banks except a state bank, which was chartered in 1819, with a capital of $4,000,000. This was repealed and a new bank chartered, which speedily failed. In 1835 a new bank was chartered, capital $1,500,000 to $2,500,000. These banks suspended in 1837, going into liquidation in 1842, and no banks existed in the state until the adoption of the free banking law in 1851. The general progress to 1862, was as follows:

| | No. | Capital. | |
|---|---|---|---|
| 1819, | 2 | $140,910 | |
| 1835, | 2 | 278,739 | State bank charter. |
| 1838, | 2 | 5,473,050 | Failure. |
| 1843, | | | Liquidation. |
| 1854, | 29 | 2,513,790 | Free banking law. |
| 1857, | 45 | 4,679,325 | Suspension. |
| 1859, | 103 | 8,900,000 | Recovery. |
| 1862, | 18 | 712,351 | War produced a crisis. |

Michigan was admitted as a state in January, 1837, but there had been already a number of small banks authorized by the territorial legislature. These rapidly multiplied under the state, during the speculative year 1837. In the early part of that year there existed 20 banks, with a capital of $1,918,361. These were a total wreck, and in March, 1838, a general banking law was passed, in order, as was alleged, to throw the business open. In one year, 49 banks, with a capital of $3,915,000, were projected. Of these, 42 went into operation. Those banks were not required to redeem their issues on demand. The result was utter insolvency, inflicting a heavy loss upon the public. In 1849, the "free banking law" was adopted, with personal liabilities to stockholders. The progress was as follows:—

| | No. | Capital. | |
|---|---|---|---|
| 1835, | 8 | $658,980 | Territorial government. |
| 1837, | 9 | 1,400,000 | State and general law. |
| 1838, | 43 | 2,317,765 | Revulsion. |
| 1844, | 3 | 202,650 | Liquidation. |
| 1849, | 5 | 392,530 | Free law. |
| 1859, | 4 | 755,461 | |
| 1862, | 4 | 786,455 | |

Iowa was admitted into the Union in 1846. It had at Dubuque the Miners' Bank, chartered by Wisconsin before the erection of Iowa territory, in operation since 1838. In 1858 it adopted the free banking law, and authorized a State Bank, which, with its branches, organized in 1859. In 1862, the State Bank and its 15 branches had $720,890 capital.

Wisconsin was admittted into the Union in 1848. It had, during some ten years, two banks, that of Mineral Point and the Bank of Wisconsin; these failed, and in 1851 a new bank was started at Milwaukee. In 1854 the free banking law was adopted; since that time the progress has been as follows:—

| | No | Capital. | |
|---|---|---|---|
| 1837, | 2 | $119,625 | |
| 1839, | 2 | 139,125 | Suspension. |
| 1848, | | | State admitted. |
| 1854, | 10 | 600,000 | Free law. |
| 1857, | 38 | 2,635,000 | Suspension. |
| 1859, | 98 | 7,995,000 | Expansion. |
| 1860, | 108 | 7,620,000 | Expansion. |
| 1862, | 70 | 4,397,000 | Panic. |

The operation of the free law, by retarding the convertibility of the bills of the Wisconsin banks, caused, when crops are short, exchange on the east to rule high, in other words depreciates the currency. The bank circulation was about $4,600,000.

Minnesota has made, as yet, little progress in banking. It adopted the free banking law in 1858, and several banks were started under it. In 1860 there were 17, but before May, 1862, 14 of these had failed and 2 of the remaining three did no business in the state.

Nebraska, before becoming a state, had a number of banks, chartered by the legislature, but these all went down, some in the panic of 1857 and some afterwards, and in 1862 she had not one left.

Kentucky was admitted into the Union in 1792, and in 1801 it authorized a bank, with a capital of $150,000, under the guise of an Insurance Company, authorized to issue notes. In 1804 it chartered the Bank of Kentucky, capital $1,000,000; this bank failed in 1814, but resumed in 1815. In 1817 a batch of forty banks, with $10,000,000 capital, was authorized to redeem their notes by paying out Kentucky bank-notes for them instead of specie. The result was a flood of irredeemable paper, which stimulated all kinds of speculation and jobbing, and ended in a general explosion and distress within the year. To "relieve" the people, the state chartered the Commonwealth Bank, capital $3,000,000, pledging lands south of the Tennessee river, in addition to the faith of the state, for the redemption of the bills, which creditors were required to take at par for their claims, or wait two years for their pay. The bills fell at once to fifty cents on the dollar, and which proportion of their debts creditors were thus required to lose. This gave rise to party strife, which, at the end of five years, resulted in the repeal of the law and the suppression of the paper. The United States Bank had two branches in the state, one at Lexington and one at Louisville. When, in 1833, it became evident that that institution would not be rechartered, three new banks, with branches, were authorized, capital $7,030,000; subsequently another was started. These went into operation, but suspended in 1837, resuming in 1839 with the United States Bank, and again suspended on the final failure of that concern. In 1842, the banks again resumed, and since then the number has gradually increased, as follows:

| | No. | Capital. | |
|---|---|---|---|
| 1819, | 18 | $4,307,431 | Irredeemable. |
| 1833, | 2 | 792,427 | New charter. |
| 1835, | 4 | 4,106,262 | With ten branches. |
| 1837, | 4 | 8,499,094 | Suspension. |
| 1851, | 26 | 7,536,927 | |
| 1857, | 35 | 10,596,205 | Suspension. |
| 1860, | 45 | 12,835,670 | Recovery. |
| 1862, | 57 | 15,305,500 | War time. |



Tennessee commenced banking in 1807, with the Bank of Nashville, which soon failed with great loss. In 1811 it again chartered ten banks, and a number of others were from time to time started, but failed disastrously. In 1852 the free banking law was adopted, and the progress of affairs to 1860 was as follows:—

| | No. | Capital. | |
|---|---|---|---|
| 1819, | 3 | $1,545,867 | Disastrous failure. |
| 1820, | 1 | 737,817 | State bank charter. |
| 1835, | 3 | 2,890,381 | Four branches. |
| 1837, | 3 | 5,293,079 | Suspension. |
| 1852, | 23 | 6,881,568 | |
| 1857, | 45 | 9,083,693 | Suspension. |
| 1860, | 34 | 8,067,037 | |

Arkansas had two banks that were started upon state bonds. These the state issued to the extent of $3,500,000 to the banks to form their capitals. The bonds were sold through the United States Bank, and the money obtained for them was loaned out pro rata to the stockholders, who became so by filing mortgages on their plantations and lands. Speedy ruin, of course, overtook both banks. These went into liquidation, owing the state some $3,000,000 on the bonds which were not paid. No banks were started again in Arkansas till after the war.

Mississippi is a state in which banking for a long time ran riot, but which has had but little in the last 20 years. When the state came into the Union in 1817 it had one bank, which continued with an increased capital to 1830. In that year the state chartered the Planters' Bank, with a capital of $3,000,000, two-thirds to be subscribed by the state in stock, which was issued, and the bank went into operation. Other banks were then chartered, and in 1837 there were seventeen, with eighteen branches, and a capital of $16,760,951. In that year the Union Bank was chartered, with a capital of $15,000,000 in state stock; of this amount $5,000,000 was issued, and repudiated on the ground of illegality of sale, and in 1852 the people refused, by a large vote, to pay those bonds. All the banks of Mississippi failed, and there has since been but little movement, as follows:—

| | No. | Capital. | |
|---|---|---|---|
| 1820, | 1 | $900,000 | |
| 1830, | 1 | 950,600 | Capital increased. |
| 1834, | 1 | 2,666,805 | |
| 1837, | 17 | 16,760,951 | 18 branches. |
| 1838, | 11 | 19,231,123 | Suspension. |
| 1840, | 18 | 30,379,403 | Failure. |
| 1851, | 1 | 118,460 | |
| 1859, | 2 | 1,100,000 | |
| 1861, | 0 | | All failed. |

Missouri had one bank when it came into the Union in 1821, but it failed disastrously. The State Bank of Missouri and branches continued to be the only institution up to 1836, when a law was passed authorizing others, and the progress to 1862, was as follows :—

| | No. | Branches. | Capital. | |
|---|---|---|---|---|
| 1819, | 1 | | $250,000 | |
| 1837, | 1 | 1 | 533,350 | State bank. |
| 1839, | 1 | 1 | 1,027,870 | |
| 1857, | 5 | 5 | 2,620,615 | Suspension. |
| 1859, | 17 | 5 | 5,796,781 | Expansion. |
| 1860, | 9 | 29 | 9,082,951 | |
| 1862, | 44 | — | 13,884,383 | |

Louisiana came into the Union in 1812, with one bank, having a capital of $500,000. This was increased to three banks in 1815, capital $1,432,000. The progress subsequently was not great until after 1830, when the speculative spirit of those years was largely developed in Louisiana, and thence to 1860, was as follows :—

| | No. | Branches. | Capital. | |
|---|---|---|---|---|
| 1830, | 3 | | $4,665,980 | |
| 1837, | 16 | 31 | 36,769,455 | Suspension. |
| 1840, | 16 | 31 | 41,711,214 | Failure. |
| 1843, | 6 | 22 | 20,929,340 | Liquidation. |
| 1851, | 6 | 22 | 12,370,390 | Free bank law. |
| 1857, | 6 | | 22,800,830 | Suspension. |
| 1860, | 13 | — | 24,496,866 | |

The free banking law was adopted in 1853, and four banks were started under its provisions, which required the banks to keep one third of their liabilities in specie on hand.

Alabama has had experience of a disastrous nature in state banking, and there has been little enterprise in that direction since the failure of the State Bank. When she came into the Union in 1819 she had one bank, with a capital of $321,112. In 1830 she had two banks. It was then supposed that by embarking in banking, the state might derive profits enough to pay all the state expenses and dispense with taxation. Accordingly, state bonds were issued to form the capital of the State Bank, which however, soon failed, and the state was saddled with a debt of some $11,000,000.

The progress was as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1819, | 1 | $321,112 | |
| 1830, | 2 | 781,010 | |
| 1837, | 3 | 10,141,806 | Suspension. |
| 1840, | 3 | 14 379,255 | Liquidation. |
| 1843, | 1 | 1,500,000 | Bank of Mobile. |
| 1851, | 1 | 1,500,000 | Free banking law. |
| 1857, | 4 | 2,297,800 | Suspension. |
| 1860, | 8 | 4,901,000 | |

Virginia chartered a bank as early as 1804 for 53 years, the Bank of Virginia, capital $1,500,000, since enlarged. In 1830 there were four banks, and the change was not great down to 1851, when the free law was adopted, but the charters of the old banks were renewed as they expired. The course of events was as follows :—

| | No. | Branches. | Capital. | |
|---|---|---|---|---|
| 1819, | 3 | | $5,112,192 | |
| 1830, | 4 | 18 | 5,571,181 | |
| 1837, | 5 | 18 | 6,732,500 | Suspension. |
| 1839, | 5 | 20 | 7,458,248 | |
| 1840, | 6 | | 10,363,362 | |
| 1851, | 6 | 20 | 9,731,370 | Free banking law. |
| 1857, | 22 | 40 | 14,651,600 | Suspension. |
| 1860, | 24 | 41 | 16,005,156 | |

North Carolina began her bank career in 1804, in granting a charter for $250,000 capital. From that time the number and amount of capital steadily increased, without any material deviation from a steady course, until 1860, as follows :—

| | No. | Branches. | Capital. | |
|---|---|---|---|---|
| 1810, | 3 | | $2,964,887 | |
| 1830, | 3 | | 3,195,000 | |
| 1837, | 3 | 7 | 2,880,590 | Suspension. |
| 1850, | 3 | 12 | 3,789,250 | |
| 1860, | 12 | 18 | 6,526,488 | |

South Carolina was more variable in its banking movement. Its first institution was the State Bank. In 1820 the capital was pledged as security for the state debt, and it became a regular bank. The progress of the state to 1860 was as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1792, | 1 | $675,000 | |
| 1711, | 4 | 3,475,000 | |
| 1820, | 3 | 2,474,000 | |
| 1836, | 10 | 8,636,118 | |
| 1837, | 4 | 4,100,000 | Suspension. |
| 1839, | 11 | 9,153,498 | Eight new charters. |
| 1850, | 14 | 13,179,131 | |
| 1860, | 20 | 962,062 | |

Georgia had a regular supply of banks after the expiration of the first United States Bank in 1811, when she chartered an institution with $215,000 capital. In 1820 this had increased to four banks, with a capital of $3,401,510, and the progress to 1860, was as follows :—

| | No. | Capital. | |
|---|---|---|---|
| 1811, | 1 | $215,000 | Old U. S. Bank expired. |
| 1816, | 3 | 1,502,000 | New " chartered. |
| 1820, | 4 | 3,401,510 | |
| 1833, | 13 | 6,534,691 | Deposits removed. |
| 1837, | 16 | 11,438,828 | Suspension. |
| 1840, | 39 | 15,098,694 | |
| 1846, | 22 | 8,970,789 | |
| 1857, | 30 | 16,015,256 | Suspension. |
| 1860, | 20 | 16,689,560 | |

District of Columbia banks were established as early as 1792, in the district, and increased pretty rapidly, as follows :—

| | No. | Capital. |
|---|---|---|
| 1792, | 1 | $500,000 |
| 1802, | 2 | 1,500,000 |
| 1811, | 4 | 2,3[illegible]1,395 |
| 1815, | 10 | 4,078,295 |
| 1820, | 13 | 5,525,319 |
| 1830, | 9 | 3,879,574 |
| 1837, | 7 | 2,204,445 |
| 1844, | 6 | 1,649,280 |

Most of the charters expired, and not being renewed, the concerns gradually went into liquidation.

Florida came into the Union in 1845, with a load of five banks that had been chartered by the territory in 1838, with an aggregate capital of $2,113,000. These were mostly based upon $3,500,000 territorial bonds, issued to the banks for capital, and sold in London. The concerns failed almost as soon as they got the money, and went into liquidation, when the state repudiated the bonds, and there were no banks in Florida, until 1860, when two were started, with $300,000 capital.

From this sketch of banking in each state, it is to be observed that the creation of banks has been due more to the desire to borrow money through their operation than to lend it. The mistaken idea that they could supply capital, was the temptation to their creation, and disastrous failure everywhere attended the experiment. Gradually a principle of sound banking vindicated itself amid numerous disasters, and actual capital came to be employed in the business.

## CHAPTER III.

### BANKS OF THE UNITED STATES—CLEARING HOUSES—PRIVATE BANKING.

Having sketched the course of events in each state, we may recapitulate the leading features of all the state banks :—

BANKS OF ALL THE UNITED STATES—TOTAL OF IMPORTS AND EXPORTS—POPULATION.

| | No. | Capital. | Loans. | Circulation. | Specie. | Deposits. | Imports & Exports. | Population. |
|---|---|---|---|---|---|---|---|---|
| 1791, | 3 | $2,000,000 | ......... | ......... | ......... | ......... | $48,212,041 | 3,929,827 |
| 1800, | 32 | 23,550,000 | ......... | ......... | ......... | ......... | 162,224,548 | 5,305,925 |
| 1811, | 89 | 52,601,601 | ......... | $28,100,000 | $15,400,000 | ......... | 144,716,833 | 7,449,960 |
| 1815, | 208 | 82,259,590 | ......... | 45,500,000 | 17,000,000 | ......... | 165,599,027 | 8,353,338 |
| 1816, | 246 | 89,822,422 | ......... | 68,000,000 | 19,000,000 | ......... | 229,024,452 | 8,595,806 |
| 1820, | 308 | 137,110,611 | ......... | 44,863,344 | 19,820,240 | $35,950,470 | 144,141,669 | 9,638,131 |
| 1830, | 330 | 145,192,268 | 200,451,214 | 61,323,898 | 22,114,917 | 55,559,928 | 144,726,428 | 12,866,020 |
| 1837, | 634 | 290,772,091 | 525,115,702 | 149,185,890 | 37,915,340 | 127,397,185 | 258,408,593 | 15,681,467 |
| 1840, | 901 | 358,442,692 | 462,896,523 | 106,968,572 | 33,105,155 | 75,686,857 | 239,227,465 | 17,069,453 |
| 1843, | 691 | 228,861,948 | 254,544,937 | 58,563,608 | 33,515,806 | 56,168,628 | 149,100,279 | 18,713,479 |
| 1846, | 707 | 196,894,309 | 312,114,404 | 105,552,427 | 42,012,095 | 96,913,070 | 235,180,313 | 20,515,871 |
| 1854, | 1,208 | 301,376,071 | 557,397,779 | 204,689,207 | 59,410,353 | 188,188,744 | 582,803,445 | 26,051,890 |
| 1857, | 1,416 | 370,834,686 | 684,456,889 | 214,778,822 | 58,349,838 | 230,351,352 | 723,850,823 | 28,406,974 |
| 1860, | 1,562 | 421,880,095 | 691,945,580 | 207,102,477 | 83,594,537 | 253,802,129 | 854,500,000 | 31,443,321 |
| 1863, | 1,466 | 405,045,829 | 648,601,863 | 238,677,208 | 101,227,367 | 393,686,126 | 594,097,046 | 34,478,633 |

This table shows the number of banks, with their aggregate capital, at important eras. As in 1791, when the national bank and mint went into operation; 1811, when the bank charter expired; 1815, when the numerous banks that had sprung into being on the dissolution of the National Bank, were all suspended; in 1816, when the peace, bringing with it large imports of goods, and a heavy drain of specie to Europe and Asia, increased the confusion and aided the re establishment of a national bank; 1820, when that bank, in full operation, was staggering under adverse exchanges and the operation of local banks; 1830, when five years of successful working, after the revulsion of 1825, and under a high tariff, had given confidence to the public; 1837, when the rivalry between the state and the national banks had, aided by the state of affairs in Europe, stimulated speculation, which resulted in the revulsion of that year; 1840, when the number of banks had reached the highest point, under efforts to restore prosperity by paper credits; 1843, the lowest point of depression after the failure of those efforts, and the liquidation of the unsound banks; 1846, when the bank capital was at a low point, but bank credits had begun to multiply under the effects of the famine abroad; 1854, when the gold discoveries had prompted the creation of five hundred new banks; the panic period of 1857; the partial restoration of 1860; and the contraction and general upheaval in all financial operations produced by two years of war, in 1863.

The mere figures, showing the magnitude of the bank movement, do not indicate the changes in the manner of doing business, nor do they indicate any unsafe expansion, except as in connection with the business they represent. Thus, in 1837, the bank loans were $525,000,000, and their circulation $149,000,000. Events proved that those loans were of the most speculative and unsafe character. In 1860, the loans were $691,900,000, and the circulation $207,000,000. Yet these larger figures were very far from being excessive. They represent but $6 circulation per head of the people, while that of 1837 was nearly $10 per head. The imports and exports, were, in 1837, but half the amount of bank loans. In 1860 they exceeded the amount of bank loans, but in 1863 were fifty-four million less. It is thus evident, that the larger sum of bank loans represents actual business, while those of 1837 represented only speculative values. This fact of the nature of loans made is the key to sound banking. It is a matter which depends upon the judgment and skill of the banker, and it cannot be regulated by law. Hence the futility of all the laws that have been devised to prevent banks from breaking. It is to be remembered, that the bank loans form but a portion of the credits which are the great purchasing power in trade. Almost all the wholesale business of the country is done with the notes of individuals, running for a longer or less time. These are entirely independent of law or banks. In a time of great mercantile confidence and speculative activity, business men are disposed to buy on credit, and their competition for produce and merchandise causes a rise in prices. This rise stimulates greater activity, which reacts upon prices until revulsion is brought about. The agency which the banks have in this matter is to discount a portion of the notes which a dealer takes in exchange for the merchandise he sells. The bank in discounting does not actually lend any money. It merely operates a canceling of credits by book accounts. Thus, a merchant buys goods and gives his note at six months. He then deposits what money he receives in the course of business to await the maturity of the note. As the period approaches, he finds that he has not money enough, but he has in his pocket-book a number of notes that he has taken for goods. These he takes to the bank and offers as collateral security for his own note, that he offers for discount. The bank making the discount places the amount to his credit. He draws a check against that credit in favor of the note he has to pay, and the two entries cancel each other. There has been no money used, but one kind of promise has supplanted another. As the crops come forward from the country, the drafts drawn against them pay the notes held by the merchant and lodged as collateral. Dearness or scarcity of money in the market depends mainly upon the disposition of the banks to facilitate the canceling of credits, and in this the institution affects to be governed by the state of the foreign trade. If the disposition to buy goods has been very active and prices are consequently so high as to pay good profits on imports, the arrivals of merchandise will be large and the exports proportionably small. This involves a demand for specie which the banks avoid, by refusing to come under new obligations. A competition in curtailment sets in. The bank that curtails the most rapidly will have the balances in its favor from the other banks, and will command their specie. Each endeavors to attain such a position. The pressure becomes great, the public alarmed, and individual depositors draw their specie, which exhausts the banks, and they stop. This was the state of affairs in 1857.

The general tendency of the banks has been, under the teachings of experience, to equalize balances and to insist on prompt payment. In the case of circulation this was done in New England by the Suffolk system, and in New York and most other states by the free law, which required a deposit of state stocks of dollar for dollar of the circulation. It is obvious, however, that these regulations in no degree affect discounts and those operations where circulation is not in question; as in the checks of individuals, by which a large portion of credits are transferred. In New York city there were about 50 banks, each of which received checks on all the other banks, and had checks drawn upon it in favor of all others. There were also drafts and bills from abroad, constanly coming to each to be paid by others. Up to 1853, all the banks employed each a man to go round and collect all these checks and drafts each day, and each bank kept fifty accounts open. To obviate this and to enforce settlement, the "clearing house" was devised. By this system, each bank sends thither every day a clerk, with all the demands it has against all other banks. The fifty or sixty clerks assembled make a mutual exchange of all claims, and the balance, if any, is struck, and each bank pays in cash the amount of that balance. The amount of accounts depends upon the activity of business. The clearing house commenced in October, 1853, and its operations have been as follows:—

| | Amount Exchanged. | Balances Paid. | Average Daily Exchanges. |
|---|---|---|---|
| 1854, | $5,750,455,987 | $297,411,493 | $19,104,505 |
| 1856, | 6,906,213,328 | 334,714,489 | 22,278,108 |
| 1858, | 4,756,664,386 | 314,238,910 | 15,393,736 |
| 1860, | 7,231,143,057 | 351,000,000 | 23,401,757 |
| 1862, | 6,871,443,591 | 415,530,331 | 22,237,682 |
| 1864, | 24,097,196,656 | 885,719,205 | 77,984,455 |
| 1866, | 28,717,146,914 | 1,066,135,106 | 93,541,195 |
| 1870, | 27,804,539,406 | 1,036,484,822 | 90,274,475 |
| 1872, | 32,636,997,404 | 1,213,293,827 | 105,964,277 |
| 1873, | 33,972,773,943 | 1,152,372,198 | 111,022,137 |
| 1875, | 23,042,276,858 | 1,104,346,845 | 75,301,558 |
| 1876, | 19,874,815,361 | 1,009,532,037 | 64,738,812 |
| 1878, | 19,922,733,947 | 951,970,454 | 65,106,974 |
| 1880, | 37,182,128,621 | 1,516,538,631 | 121,510,224 |
| 1881, | 48,565,818,212 | 1,776,018,162 | 165,055,201 |

The emergencies of the war required the issue of demand notes by the Government, of small denominations to serve for circulation, as well as for the putting forth of bonds, treasury notes, and loans of various kinds. At first these demand notes were the equivalent of gold and silver, and were receivable in payment of customs duties, as well as all other moneys due to the United States; but the gradual advance in the price of gold made them so valuable as to take them out of the circulation, and cause them to be hoarded as gold. Congress then authorized the issue of legal-tender notes of small denominations, receivable for the payment of all dues to the United States, except customs, which must be paid in gold, the coin being needed to pay the interest on that portion of the national debt upon which interest in gold was guaranteed. Of these legal-tender notes, or *greenbacks*, $450,000,000 were issued, and on the 3d of January, 1882, there was outstanding only $346,740,936. Beside this, Congress authorized the issue of postal and fractional currency to the extent of $50,000,000, but the amount issued never exceeded $45,000,000, and was, January 3, 1882, only $7,075,927. From our brief review of the condition of the banks in the various states, from 1860 to 1863, it will be apparent that they were rapidly approaching a crisis, their issues being very generally distrusted, and the discounts on them so perplexing and ruinous to the holders, that every one who could, shunned them. The issue of legal-tender notes and fractional currency, while it was absolutely necessary to the existence and efficiency of the National Government, in the great war it was conducting, was seen by the great financiers who were managing the nation's finances, to be but a temporary expedient, and liable to the serious objection, as a permanent currency, of expanding most when it should be contracted, and least, when expansion was necessary. But a national currency was needed; for the people would not go back to the old uncurrent money and the mysteries of the counterfeit detectors and uncurrent money lists, and the banks of the country could not issue notes which would inspire general confidence. The national banking system, devised by Mr. Chase, then Secretary of the Treasury, and based in its main features upon the New York Free Banking law, though with additional safeguards for depositors and bill holders, satisfied this demand fully, and at the same time furnished a home market for $370,000,000 or more of the bonds and Treasury Notes the Government was then issuing. The capital of the National Banks consisted of these Bonds, Treasury Notes, etc., and these being deposited in the U. S. Treasury, the Controller of the currency issued to the banks National Bank notes of different denominations (printed from the same plates, but with the name and place of the bank and the coat of arms of the state to which it belonged inserted), to the amount of not more than ninety per cent. of the par value of the bonds. The amount of circulation was at first limited to $300,000,000 but by subsequent acts it was increased till it now exceeds $360,000,000. Minor modifications of the original law have been made providing for rigid and frequent inspection of the condition of each bank, redemption in New York City, and avoiding all depreciation of the notes. At first the development of the National Banks was slow, as their advantages were not appreciated, and the state and local banks made a very bitter fight against them, but Congress passed, in 1865, an amendment to the Internal Revenue Law, taxing the circulation of the state banks so heavily that they were glad to withdraw it from the market, and most of them reorganized as National Banks, which from this time had a rapid growth.

The following table shows the progress of the National Banks:—

| | Year. | No. of Banks. | Capital. | Circulation. | | Year. | No. of Banks. | Capital. | Circulation. |
|---|---|---|---|---|---|---|---|---|---|
| Oct., | 1863, | 66 | $7,188,393 | | Oct., | 1873, | 1,976 | 491,000,000 | 340,300,000 |
| " | 1864, | 507 | 86,782,802 | 45,260,504 | " | 1874, | 2,004 | 493,800,000 | 334,200,000 |
| " | 1865, | 1,513 | 393,157,206 | 171,321,903 | " | 1875, | 2,087 | 504,800,000 | 319,100,000 |
| " | 1866, | 1,643 | 415,278,969 | 280,129,558 | " | 1876, | 2,089 | 499,800,000 | 292,200,000 |
| " | 1867, | 1,643 | 420,073,415 | 293,887,941 | " | 1877, | 2,080 | 479,500,000 | 291,900,000 |
| " | 1868, | 1,645 | 420,634,511 | 295,769,489 | " | 1878, | 2,053 | 466,200,000 | 301,900,000 |
| " | 1869, | 1,617 | 426,399,151 | 293,593,645 | " | 1879, | 2,048 | 454,100,000 | 313,800,000 |
| " | 1870, | 1,615 | 430,399,301 | 291,798,640 | " | 1880, | 2,090 | 457,600,000 | 317,300,000 |
| " | 1871, | 1,784 | 462,518,602 | 322,952,030 | " | 1881, | 2,132 | 463,800,000 | 320,200,000 |
| " | 1872, | 1,919 | 479,600,000 | 335,100,000 | | | | | |

COMPARATIVE STATEMENTS OF THE NATIONAL BANKS FOR ELEVEN YEARS.

The following table exhibits the resources and liabilities of the national banks for eleven years, at nearly corresponding dates, from 1871 to 1881, inclusive:

| | Oct. 2, 1871. | Oct. 3, 1872. | Sept.12 1873. | Oct. 2, 1874. | Oct. 1, 1875. | Oct. 2, 1876. | Oct. 1, 1877. | Oct. 1, 1878. | Oct. 2. 1879. | Oct. 1, 1880. | Oct. 1, 1881. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1,767 banks. | 1,919 banks. | 1,976 banks. | 2,004 banks. | 2,087 banks. | 2,089 banks. | 2,080 banks. | 2,053 banks. | 2,048 banks. | 2,090 banks. | 2,132 banks. |
| RESOURCES. | Millions. | Millions. | Millions. | Millions. | Millions. | Millions. | Millions. | Millions. | Millions | Millions. | Millions. |
| Loans | 831.6 | 877.2 | 944.2 | 954.4 | 984.7 | 931.3 | 891.9 | 834.0 | 878.5 | 1,041.0 | 1,173.8 |
| Bonds for circulation | 364.5 | 382.0 | 388.3 | 383.3 | 370.3 | 337.2 | 336.8 | 347.6 | 357.3 | 357.8 | 363.3 |
| Other U. S. bonds | 45.8 | 27.6 | 23.6 | 28.0 | 28.1 | 47.8 | 45.0 | 94.7 | 71.2 | 43.6 | 56.5 |
| Stocks, bonds, &c | 24.5 | 23.5 | 23.7 | 27.8 | 33.5 | 34.4 | 34.5 | 36.9 | 39.7 | 48.9 | 61.9 |
| Due From banks | 143.2 | 128.2 | 149.5 | 134.8 | 144.7 | 146.9 | 129.9 | 138.9 | 167.3 | 213.5 | 230.8 |
| Real estate | 30.1 | 32.3 | 34.7 | 38.1 | 42.4 | 43.1 | 45.2 | 46.7 | 47.8 | 48.0 | 47.3 |
| Specie | 13.2 | 10.2 | 19.9 | 21.2 | 8.1 | 21.4 | 22.7 | 30.7 | 42.2 | 109.3 | 114.3 |
| Legal-tender notes | 107.0 | 102.1 | 92.4 | 80.0 | 76.5 | 84.2 | 66.9 | 64.4 | 69.2 | 56.6 | 53.2 |
| National Bank notes | 14.3 | 15.8 | 16.1 | 18.5 | 18.5 | 15.9 | 15.6 | 16.9 | 16.7 | 18.2 | 17.7 |
| Custom House exchanges | 115.2 | 125.0 | 100.3 | 109.7 | 87.9 | 100.0 | 74.5 | 82.4 | 113.0 | 121.1 | 189.2 |
| U. S. certificates of deposit | ....... | 6.7 | 20.6 | 42.8 | 48.8 | 29.2 | 33.4 | 32.7 | 26.8 | 7.7 | 6.7 |
| Due from U. S. Treasury | ...... | ....... | ....... | 20.3 | 19.6 | 16.7 | 16.0 | 16.5 | 17.0 | 17.1 | 17.5 |
| Other resources | 41.2 | 25.2 | 17.3 | 18.3 | 19.1 | 19.1 | 28.7 | 24.9 | 22.1 | 23.0 | 26.2 |
| Totals | 1,730.6 | 1,755.8 | 1,830.6 | 1,877.2 | 1,882.2 | 1,827.2 | 1,741.1 | 1,767.3 | 1,868.8 | 2,105.8 | 2,358.4 |
| LIABILITIES. | | | | | | | | | | | |
| Capital stock | 458.3 | 479.6 | 491.0 | 493.8 | 504.8 | 499.8 | 479.5 | 466.2 | 454.1 | 457.6 | 463.8 |
| Surplus fund | 101.1 | 110.3 | 120.3 | 129.0 | 134.4 | 132.2 | 122.8 | 116.9 | 114.8 | 120.5 | 128.1 |
| Undivided profits | 42.0 | 46.6 | 54.5 | 51.5 | 53.0 | 46.4 | 44.5 | 44.9 | 41.3 | 46.1 | 56.4 |
| Circulation | 317.4 | 335.1 | 340.3 | 334.2 | 319.1 | 292.2 | 291.9 | 301.9 | 313.8 | 317.3 | 320.2 |
| Due to depositors | 631.4 | 628.9 | 640.0 | 683.8 | 679.4 | 666.2 | 630.4 | 668.4 | 736.9 | 887.9 | 1,083.1 |
| Due to banks | 171.9 | 143.8 | 173.0 | 175.8 | 179.7 | 179.8 | 161.6 | 165.1 | 201.2 | 267.9 | 294.9 |
| Other liabilities | 8.5 | 11.5 | 11.5 | 9.1 | 11.8 | 10.6 | 10.4 | 7.9 | 6.7 | 8.5 | 11.9 |
| Totals | 1,730.6 | 1,755.8 | 1,830.6 | 1,877.2 | 1,882.2 | 1,827.2 | 1,741.1 | 1,767.3 | 1,868.8 | 2,105.8 | 2,358.4 |

We supplement this account of the condition of the National Banks with that of the state banks, trust companies, private banking houses, and savings banks of each state and territory to May 31, 1881. [See next page.]

As we have intimated already, under existing laws, these state banks, trust companies, private banking houses, and savings banks, 4,681 in number, are not allowed to issue any circulating notes of their own. They receive and pay out over their counters National bankbills, legal-tender notes (commonly called *greenbacks*), coupons of U. S. coupon-bonds, gold and silver coin, and to such amount as is required, subsidiary coin of all denominations, but not now fractional currency. They are banks of discount and deposit. We are now prepared to give approximately the amount of money in circulation in the country on the 1st of November, 1881:—

| | |
|---|---|
| Gold Coin, | $469,000,000 |
| Silver Legal Tender, | 100,600,000 |
| Silver Subsidiary, | 80,400,000 |
| United States issues, | 346,681,016 |
| National Bank Notes and Gold Bank Notes, | 359,863,000 |
| Silver Certificates, | 58,838,770 |
| Total, | $1,415,382,786 |
| Of the Specie there is held in the Treasury, | $109,758,672 |
| In the National Banks, | 107,450,756 |
| In State Banks, including Silver Certificates, | 19,901,491 |
| Silver in National and other Banks, | 7,112,567 |
| In the Treas., paper money less certificates, | 22,774,830 |
| In National Banks, including certificates, | 77,630,917 |
| In other Banks and Savings Banks, | 39,173,560 |
| | $383,802,793 |
| Deduct from total, | 1,415,382,786 |
| | $1,031,579,993 |

Making a total of gold, silver, and currency in circulation, aside from treasury and bank reserves, of $1,031,579,993, or a little more than $20 to each person in our population. This is not, as will readily be understood, by any means the measure of our business transactions; for many times this amount is paid out in checks, which pass through the banks without the paying out of either specie or currency. The ratio of checks to notes and coin in New York, in 1881, was 98.80 to 1.20 per cent.

NUMBER OF STATE BANKS AND TRUST COMPANIES, PRIVATE BANKERS, AND SAVINGS BANKS WITH THE AVERAGE AMOUNT OF THEIR CAPITAL, DEPOSITS, AND INVESTMENTS IN UNITED STATES BONDS FOR THE SIX MONTHS ENDING MAY 31, 1881.

| | States and Territories. | Total. | | | | |
|---|---|---|---|---|---|---|
| | | Banks. | Capital. | Deposits. | Invested in U. S. Bonds. | |
| 1 | Maine | 66 | $53,200 | $24,363,290 | $4,056,618 | 1 |
| 2 | New Hampshire | 72 | 76,000 | 32,163,124 | 740,091 | 2 |
| 3 | Vermont | 22 | 352,804 | 10,016,910 | 622,525 | 3 |
| 4 | Massachusetts | 163 | 310,000 | 164,637,832 | 14,670,009 | 4 |
| 5 | Boston | 62 | 4,855,730 | 70,644,577 | 7,316,624 | 5 |
| 6 | Rhode Island | 55 | 3,719,789 | 43,039,201 | 5,170,535 | 6 |
| 7 | Connecticut | 106 | 2,620,100 | 84,289,272 | 7,049,889 | 7 |
| | New England States | 546 | 11,987,623 | 429,184,206 | 39,626,291 | |
| 8 | New York | 300 | 8,762,680 | 183,626,465 | 57,094,710 | 8 |
| 9 | New York City | 563 | 66,010,403 | 343,830,575 | 99,916,629 | 9 |
| 10 | Albany | 12 | 616,000 | 15,775,441 | 3,315,825 | 10 |
| 11 | New Jersey | 48 | 1,238,914 | 23,877,530 | 8,053,089 | 11 |
| 12 | Pennsylvania | 246 | 7,858,694 | 31,947,161 | 744,996 | 12 |
| 13 | Philadelphia | 74 | 2,658,894 | 64,831,097 | 6,806,890 | 13 |
| 14 | Pittsburgh | 30 | 4,019,335 | 17,887,623 | 3,015,930 | 14 |
| 15 | Delaware | 7 | 609,561 | 2,299,392 | 10,000 | 15 |
| 16 | Maryland | 11 | 507,074 | 887,742 | 267,651 | 16 |
| 17 | Baltimore | 39 | 2,640,698 | 27,859,420 | 10,981,418 | 17 |
| 18 | Washington | 7 | 364,000 | 4,144,875 | 318,614 | 18 |
| | Middle States | 1,337 | 95,286,253 | 716,967,321 | 190,525,752 | |
| 19 | Virginia | 74 | 3,068,985 | 9,286,961 | 264,825 | 19 |
| 20 | West Virginia | 19 | 1,228,983 | 4,306,402 | 102,407 | 20 |
| 21 | North Carolina | 13 | 504,640 | 1,165,763 | 50 | 21 |
| 22 | South Carolina | 14 | 549,956 | 1,914,267 | 45,000 | 22 |
| 23 | Georgia | 54 | 3,438,668 | 6,199,163 | 7,000 | 23 |
| 24 | Florida | 7 | 101,079 | 539,449 | ............ | 24 |
| 25 | Alabama | 27 | 1,179,085 | 2,481,642 | 800 | 25 |
| 26 | Mississippi | 28 | 989,872 | 2,144,493 | 170,973 | 26 |
| 27 | Louisiana | 3 | 146,329 | 35,812 | 30,000 | 27 |
| 28 | New Orleans | 13 | 2,271,932 | 5,149,585 | 395,161 | 28 |
| 29 | Texas | 120 | 4,047,964 | 8,811,029 | 14,000 | 29 |
| 30 | Arkansas | 14 | 217,302 | 679,509 | 66,480 | 30 |
| 31 | Kentucky | 75 | 6,052,294 | 9,002,299 | 171,177 | 31 |
| 32 | Louisville | 15 | 5,145,554 | 6,631,685 | 249,922 | 32 |
| 33 | Tennessee | 31 | 1,796,536 | 3,474,487 | 211,596 | 33 |
| | Southern States | 507 | 30,739,179 | 61,822,546 | 1,729,391 | |
| 34 | Ohio | 246 | 5,509,583 | 24,495,977 | 936,899 | 34 |
| 35 | Cincinnati | 12 | 1,374,317 | 5,421,863 | 340,299 | 35 |
| 36 | Cleveland | 8 | 1,059,667 | 15,861,757 | 2,633,711 | 36 |
| 37 | Indiana | 145 | 4,433,488 | 15,878,206 | 734,834 | 37 |
| 38 | Illinois | 330 | 4,579,378 | 23,903,504 | 1,357,305 | 38 |
| 39 | Chicago | 33 | 3,965,197 | 19,316,023 | 1,198,937 | 39 |
| 40 | Michigan | 161 | 2,445,500 | 9,017,059 | 117,241 | 40 |
| 41 | Detroit | 14 | 1,044,028 | 9,419,029 | 509,992 | 41 |
| 42 | Wisconsin | 108 | 1,830,863 | 10,106,752 | 207,196 | 42 |
| 43 | Milwaukee | 8 | 437,898 | 7,484,589 | 2,067 | 43 |
| 44 | Iowa | 337 | 5,671,468 | 18,592,795 | 360,976 | 44 |
| 45 | Minnesota | 112 | 2,875,971 | 7,754,414 | 69,622 | 45 |
| 46 | Missouri | 182 | 4,366,103 | 21,660,092 | 473,884 | 46 |
| 47 | Saint Louis | 30 | 5,763,025 | 25,112,676 | 383,825 | 47 |
| 48 | Kansas | 175 | 1,921,571 | 6,418,482 | 63,537 | 48 |
| 49 | Nebraska | 98 | 944,372 | 2,661,291 | 14,070 | 49 |
| | Western States | 1,999 | 48,222,429 | 223,104,509 | 9,404,395 | |
| 50 | Oregon | 16 | 892,844 | 1,434,568 | 256,300 | 50 |
| 51 | California | 83 | 8,847,747 | 15,662,084 | 254,290 | 51 |
| 52 | San Francisco | 24 | 11,953,172 | 68,980,629 | 11,234,921 | 52 |
| 53 | Colorado | 59 | 903,440 | 3,864,948 | 20,000 | 53 |
| 54 | Nevada | 15 | 381,851 | 1,254,649 | 100,000 | 54 |
| 55 | Utah | 12 | 208,225 | 1,582,519 | ............ | 55 |
| 56 | New Mexico | 8 | 13,333 | 459,518 | ............ | 56 |
| 57 | Wyoming | 4 | 135,208 | 421,310 | ............ | 57 |
| 58 | Idaho | 2 | 6,561 | 19,097 | ............ | 58 |
| 59 | Dakota | 37 | 216,263 | 484,335 | ............ | 59 |
| 60 | Montana | 14 | 512,706 | 904,498 | ............ | 60 |
| 61 | Washington | 9 | 284,050 | 657,015 | ............ | 61 |
| 62 | Arizona | 9 | 147,319 | 635,256 | 50,000 | 62 |
| | Pacific States, &c | 292 | 24,502,719 | 96,360,426 | 11,915,511 | |
| | United States | 4,681 | 210,738,203 | 1,527,439,008 | 253,201,340 | |

# UNITED STATES MINT.

## CHAPTER I.

ESTABLISHMENT OF MINT—STANDARD OF COINS—LAWS REGULATING COINAGE—PROGRESS OF COINAGE—PRECIOUS METALS IN THE COUNTRY.

The currency, or circulating medium of a country, is of itself a very simple matter, although complicated at times by the theories of financiers, and the efforts to make promises of a thing pass for the thing itself. In the early stages of society the products of industry constitute the wealth of the people, after they have ceased to be merely herdsmen. These products being exchanged against each other, the transactions form barter trade. As wealth increases and wants become more diversified, as well as the products of industry, by being subdivided, some common medium of value becomes requisite to meet all the wants of interchange. The precious metals have generally been adopted as this medium, because the supply is the most steady, the equivalent value most generally known, and the transportation most convenient. Hence all trade comes to be represented by a weight of pure gold or its equivalent of pure silver, and all commodities come to be valued, or called equivalent, to certain quantities of these metals. To ascertain the purity and weight of the metal offered in payment at each transaction would, however, involve difficulties that would neutralize the value of the metals as a common medium of exchange. Every man would require to be an assayer, and to be provided with scales. To obviate this the government steps in, and by means of a mint assays the metals, and weighs them into convenient pieces, placing on each a stamp, which soon becomes universally known, and this is called "money." Every nation makes the pieces of different weights, and puts in more or less pure metal. To ascertain the "*par* of exchange" between two countries, the coin of each is assayed, and the quantity of pure metal in each being ascertained, the *par* of exchange is known. When this continent was discovered its inhabitants were savages, who had little idea of property, and no trade beyond the mere exchange of their simple products. Money, except the limited use of "wampum," was unknown, and the precious metals were hardly known. The gold and copper that they had was twisted into rude ornaments; but no man would work for a piece of these metals. When the first emigrants landed, they commenced the cultivation of the earth and the interchange of its products. The accumulation of industrial products formed wealth. Their first exchanges were mere barter. As late as 1652 the payment of taxes and other dues was made in cattle, skins, and other products in Massachusetts; and tobacco was a medium of trade in Virginia. Some money existed, but this was mostly the coins brought by the immigrants from the mother country, and did not suffice for the daily wants. Massachusetts, therefore, established a mint for the coinage of shillings, sixpences, and threepences of sterling silver, which were "two pence in the shilling of less valew than the English coyne." This "pine tree shilling," so called from a pine tree on the reverse, was worth about twenty cents. This coinage gave umbrage to the mother country, and when Governor Winslow was introduced to Charles II., that usually good-natured monarch took him roughly to task for the presumption of the colony in assuming to coin money, at the same time producing the coin with the pine tree upon it. The ready wit of the governor, however, turned the rebuke, by assuring his Majesty that it was an evidence of the devotion of the colony, which struck these medals in commemoration of the escape of his Majesty in the Royal Oak, which was executed as well as the poor state of the arts in the colony would permit. The coinage was nevertheless suppressed, and the example of Massachusets was followed by Maryland with the like results. Carolina and Virginia struck some copper coins, but without much effect. There being no mint, therefore, in any of the colonies, foreign coins were circulated freely as a legal tender. The country produced none of the precious metals, but as the trade of the colonies increased, and they began to have a surplus of fish, provisions, food, tobacco, etc., beyond their own wants, to sell, they built vessels, and carried these articles, mostly fish, to the West Indies and the catholic countries of Europe; and as the mother country did not allow the colonies to buy manufactures except from herself, money was mostly had in exchange for this produce. Guineas, joes, half joes, doubloons, and pistoles of various origin constituted the gold currency, while the silver was mostly the Spanish American dollar and its fractions: the half, quarter, eighth, and sixteenth, with the pistareen and half pistareen. This silver coin flowed into the colonies from the Spanish West Indies, in exchange for fish and food; and the Spanish dollar thus came to be the best known and most generally adopted unit of money. The coin had upon its reverse the pillars of Hercules, and was known as the pillar dollar; hence the dollar mark ($), which represents "S," for "Spanish," entwining the pillars. Inasmuch as the "balance of trade" was in favor of England, the largest portion of the coin that flowed in from other quarters was sent thither, and this tendency was increased by the pernicious issues of paper money by the colonies. This paper displaced the coin, and drove it all out of the country. The exigencies of the several colonial governments caused them to make excessive issues of this "paper" or "bills of credit," and it fell to a heavy discount as compared with coin. Not being convertible at the date of the Revolution the depreciation in the several colonies was nearly as follows:—

VALUE OF THE DOLLAR AND THE £ STERLING IN COLONIAL PAPER MONEY.

| | £ sterling. | | | Dollar. | |
|---|---|---|---|---|---|
| | £. | s. | d. | s. | d. |
| New England and Virginia ... | 1 | 6 | 8 | 6 | 0 |
| New York and North-eastern . | 1 | 15 | $6\frac{2}{3}$ | 8 | 0 |
| Middle states................ | 1 | 13 | 4 | 7 | 6 |
| South Carolina and Georgia... | 1 | 0 | $8\frac{8}{9}$ | 4 | 8 |

On the formation of the new government, the terrible state of the currency first attracted attention. The country had been flooded with "continental money," which had been issued to the extent of three hundred and sixty millions for war expenses. The states had issued "bills of credit," which were depreciated as in the table; and the debased and diversified foreign coins that circulated were very few in number. Private credit hardly existed. Frightful jobbing took place in the government paper, and industry could with difficulty get its proper reward. The first effort was to give the federal government alone the right to coin money, to prohibit the states from issuing any more "bills of credit," and to get the continental money out of circulation by providing for its payment. Robert Morris had been directed to report upon the mint and a system of coinage, and he did so early in 1782. Many plans were based upon his report, and finally that of Mr. Jefferson was adopted. It conformed to the decimal notation, with the Spanish dollar as the unit: A gold piece of ten dollars, to be called the eagle, with its half and quarter; a dollar in silver; a tenth of a dollar in silver; a hundredth of a dollar in copper.

In accordance with the plan of Mr. Jefferson, a law of April 2, 1792, enacted regulations for a mint, located at Philadelphia, and the coinage proceeded. It was found that, owing to the rise in the value of copper, the cent had been made too heavy, and, January 14, 1790, it was reduced to two hundred and eight grains, and January 26, 1796, it was again reduced to one hundred and sixty-eight grains, at which rate it remained until the late introduction of nickel. The mint being established at Philadelphia, the work of coinage went on slowly, for two principal reasons. The first was that the material for coin—that is, gold and silver, no matter in what shape it may be—was obtained only, by the operation of trade, from abroad, and nearly all of it arrived at New York, the property of merchants. Now, although the government charged nothing for coining, yet, to send the metal from New York to Philadelphia during the first forty years of the government, when there was none but wagon conveyance, was expensive, and accompanied with some risk. It was not, therefore, to be expected that the merchants would undertake this without any benefit; the more so, as the same law, in the second place, still allowed the foreign coins to be legal tender. The merchant who received, say ten thousand dollars in gold coin at New York had only to lodge that coin in the local bank, and use the paper money issued by the bank. There was no necessity to send the coin to Philadelphia merely to be recoined without profit. It was also the case that in the course of the newly-developed commerce between the United States and the countries of Europe, it was found that silver had been valued too high at the mint. It was coined in the ratio of fifteen to one of gold, when its real value was nearly sixteen to one. This relative value of the two metals depends upon the respective demands and supply in the markets of the world. At about the date of the discovery of America it was ten to one; that is, ten ounces of pure silver were equal to one ounce of pure gold. When Peru and Spanish America poured in their large supplies of silver, the rate gradually fell to fifteen to one. At the close of the eighteenth century, and with the greater freedom of commerce in the first half of the nineteenth century, it was found still to decline. The reason of this is obvious, since, in any locality, the relative value of the metals will be proportioned to the local supply of either, influenced by the expense of sending either to other localities. Thus, silver may have been really fourteen to one in one place, and sixteen to one in another, and the difficulties of transportation prevented an equalization. As soon as communication became prompt and cheap the equalization took place, and the general relative value was found to be somewhat changed. The effect of this was that silver came here and gold went away. Nearly all the coinage of the mint was silver. This evil attracted the attention of the government, and a remedy was sought. This was finally found in changing the relative value of the silver to gold in the coinage by simply putting less pure gold into the eagle, and letting the silver remain as it was. The quantity of pure gold in the eagle was, therefore, by the law of June 28, 1834, reduced from 247.5 grains to 232 grains, or rather more than six and five-eighths per cent., and the quantity of alloy was slightly increased, so as to make the fineness of the gold nine-tenths, or nine grains of fine gold to one of alloy in each piece.

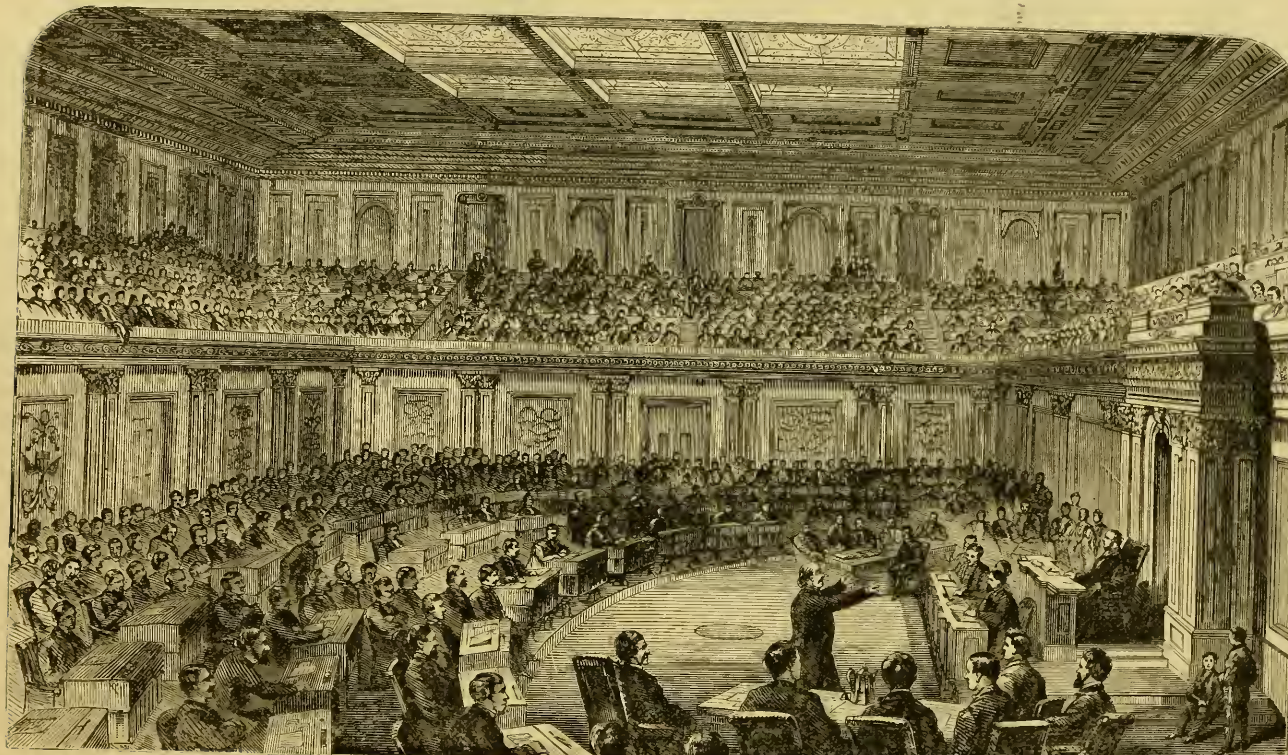
This was found not to be exact, and in 1837 the pure gold was slightly increased, and this regulation remains. Under all the laws the gold coins have been as follows:—

| | Pure gold. Grains. | Alloy. Silver. | Alloy. Copper. | Total Alloy. | Total weight. Grains. | Fineness. |
|---|---|---|---|---|---|---|
| 1792, | 247.5 | 5.62½ | 16.87½ | 22.5 | 270 | 916.7 |
| 1834, | 232.0 | 6.50 | 19.50 | 26.0 | 258 | 899.2 |
| 1837, | 232.2 | 6.45 | 19.35 | 25.8 | 258 | 900.0 |

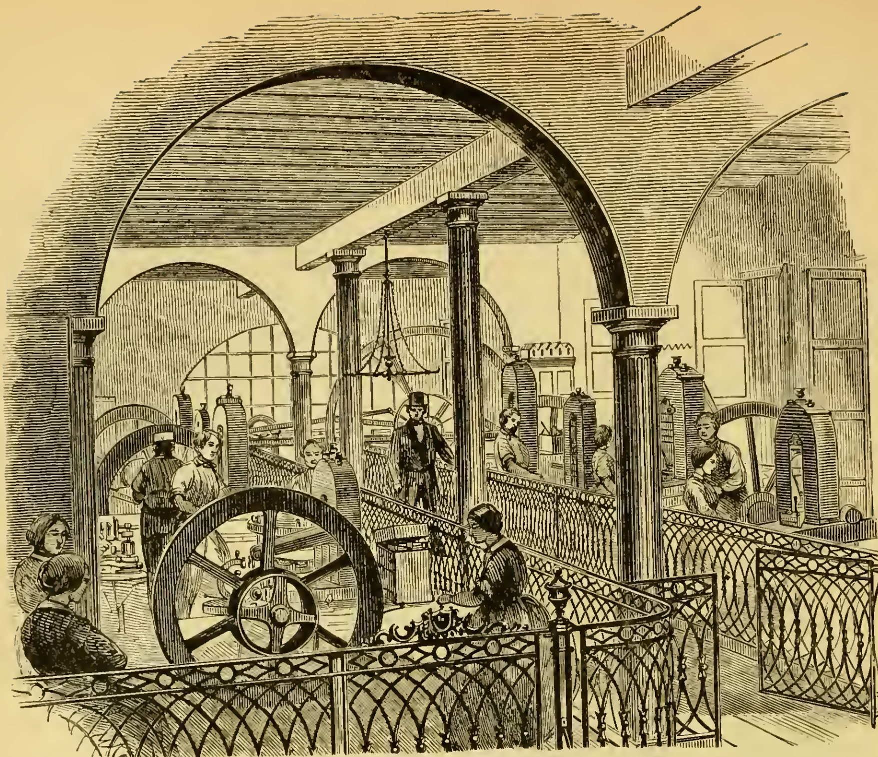
In silver the same law made the weight of the silver dollar 412½ grains instead of 416, and this is still the weight of the standard dollar. It was found necessary, some years since, to make a silver dollar for trade with China and Japan, which should be a little heavier and at that time of the full weight of silver for a coin of one hundred cents. This trade dollar of 420 grains weight was accordingly coined, and intended to be used for this purpose only. The value of silver has fluctuated very greatly during the last fifteen years, and during all that time the intrinsic value of both dollars has been less than 100 cents. At this time (April, 1882,) the trade dollar is worth 89.02, and the legal tender dollars 87.43. The standard weight of the subsidiary pieces is as follows: Half dollar, 192.9 grains; quarter dollar, 96.45; twenty cent piece, 77.16; dime, 38.58.

In all this period, up to 1838, there had been but one mint, and that at Philadelphia. In 1831, under the desire of the government to enlarge the metallic basis of the national currency, three branches were authorized, one at New Orleans, one at Charlotte, North Carolina, and one at Dahlonega, Georgia. These two latter were in mining districts, where gold began to be produced to some extent, and all three went into operation in 1838. The coinage progressed down to 1853, when, in consequence of the change brought about by the gold discoveries in California, a new law in relation to silver currency was enacted. Before giving an account of that change, we may take a table of the coinage at the mint since its organization for several periods. [See next page.]

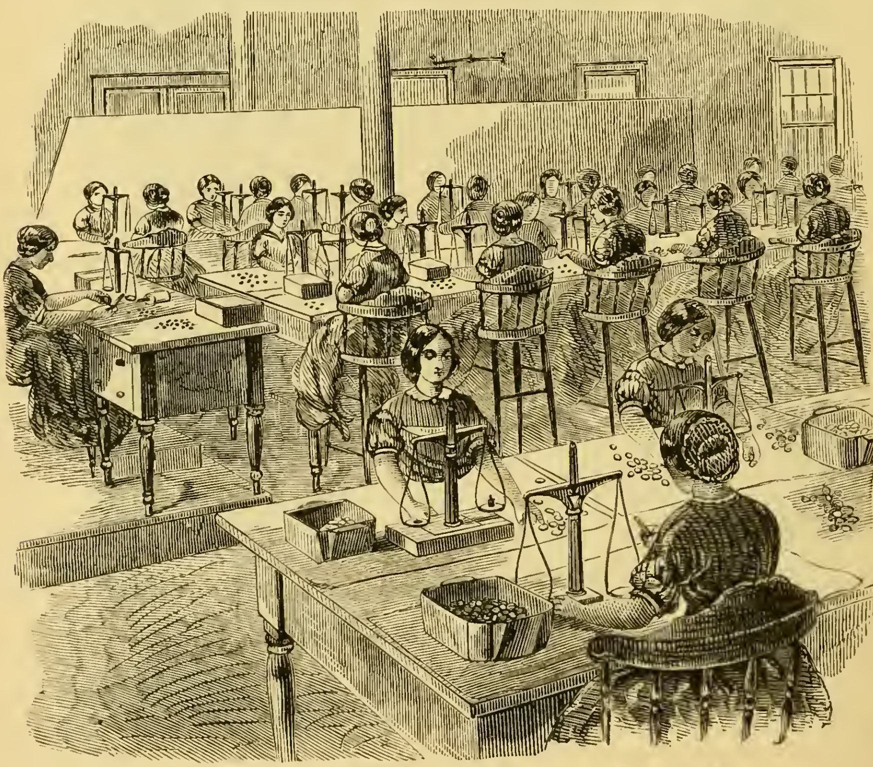
In the first twenty-seven years of the mint operation, the gold coinage was about seventy-five per cent. of the silver coinage. That whole period embraced the European war, and the first operations of the mint were to coin as much of the metals already in the country as came within their reach. In the second period, from 1821 to 1834,



NTERIOR VIEW OF THE U. S. SENATE CHAMBER.



INTERIOR OF THE MINT, PHILADELPHIA. COINING ROOM.



INTERIOR VIEW OF THE MINT, PHILADELPHIA. ADJUSTING ROOM.

UNITED STATES COINAGE.

| Period. | Gold. | Silver. | Copper and Nickel. | Total. |
|---|---|---|---|---|
| 1793 to 1848 | $76,341,440.00 | 1793 to 1852. $79,213,371.90 | | $155,554,811.90 |
| 1849 to 1873 | 740,564,438.50 | 1853 to 1873. $65,928,512.70 | 1793 to 1873. $11,919,888.55 | 818,412,839.75 |
| 1874 | 50,442,690.00 | 5,983,601.30 | 411,925.00 | 56,838,216.30 |
| 1875 | 33,553,965.00 | 10,070,368.00 | 230,375.00 | 43,854,708.00 |
| 1876 | 38,178,962.50 | 19,126,502.50 | 260,350.00 | 57,565,815.00 |
| 1877 | 44,078,199.00 | 28,549,935.00 | 62,165.00 | 72,690,299.00 |
| 1878 | 52,798,980.00 | 28,290,825 50 | 30,694.00 | 81,120,499.50 |
| 1879 | 40,986,912.00 | 27,227,882.50 | 97,798.00 | 68.312,592.50 |
| 1880 | 56,157,735.00 | 27,942,437.50 | 269,971.50 | 84,370,244.00 |
| 1881 | 78,733,864.00 | 27,649,966.75 | 405,109.95 | 106,788,940.70 |
| Totals, | $1,211,837,186.00 | $319,983,403.65 | $13,688,277.00 | $1,545,508,962.95 |

the effect of the change in the relative value of the metals of which we have spoken, became manifest, and the gold coinage was about one-sixth only of the silver coinage. In 1834 the new gold bill produced a change, and the gold coinage became nearly equal to that of silver. Soon after the passage of this law, the payment of the French indemnity, enforced under the administration of General Jackson, took place, and it was paid in the form of gold bars, of varying weight. The first of these were received at the U. S. mint, Sept., 1834, and in the next four years six hundred of them were deposited at the mint; value, $3,500,000. In 1838 the branches came into operation, and the coinage was increased by their operations and by $13,765,250 of gold of domestic production, to the close of 1848. In 1849 California gold began to make its appearance, $7,079,144 worth of it was coined in that year. The great influx of gold bullion upon the mint by far exceeded its capacity to do the work, and Congress authorized, by the act of March 3, 1849, the coinage of double eagles, or $20 pieces, and also one dollar pieces to supply the place of the silver coin, which had been drained off to California in exchange for the gold. The law of May, 1852, authorized the coinage of $3 pieces.

In ten years, to the close of 1858, the gold coinage had amounted to double the silver coinage, and the new influx of gold excited fears that the value of silver would rise rapidly as compared with gold. From 1848 to 1857 the coinage of silver was very small, while the demand for it was large. To avoid inconvenience from this cause, a new bill was passed, to take effect April 1, 1853. By this bill it was enacted that gold or silver deposited with the mint, might be cast into bars or ingots of pure metal, or standard fineness, at the option of the depositor, with a stamp designating the weight and fineness; no pieces less than ten ounces shall be other than of standard fineness; the charge for this is one-half per cent. Inasmuch as most of the gold arrives at New York, efforts were made to procure the establishment of a mint at that point. Instead, however, of a mint, an assay office was established there, and a branch mint at San Francisco, in 1854. The law allows the depositor to draw either bars or coin in return, the description desired to be stated at the time of the deposit. The production of bars and coins under all these regulations has been large, for gold as well as silver.

Until the law of 1834, the quantity of gold coin in circulation was not large. The banks supplied so large a quantity of small bills as to fill the channels of circulation for sums above a dollar, and under that amount the circulation was almost altogether small Spanish coins, which, being much depreciated by wear and tear, passed for more than their intrinsic value, and consequently flooded the country, greatly influencing retail prices. This was particularly the case with the pistareens, which, up to 1827, were taken at twenty cents, or five to the dollar, although they were really worth but eighteen and a half cents, consequently there was little other change to be had. In consequence of a report of the Mint Director of that year, they were refused at more than seventeen cents, and they very speedily disappeared from circulation, and have rarely been seen for more than 45 years. The quarters continued to circulate at twenty-five cents, although the average value was twenty-three and a half cents; the eighths were taken at twelve and a half, although they were worth only eleven and one-eighth; the sixteenth was taken at six and a quarter, although worth but five cents. It resulted that these coins became very abundant, driving out the dimes and half dimes, and in 1843 the post-office and the banks refusing them altogether, they were supplanted by the American coin, until the gold discoveries of 1848. After that event, owing to the increased production of gold, and the fact that some of the European states changed their monetary policy, making silver the sole standard of value, the latter metal became worth more in market than its nominal value in United States coin, and was gradually withdrawn from the currency, until, in 1852, silver coin became very scarce, and there was not sufficient left in circulation for the purposes of change. A premium of four per cent. was paid for dollars and half dollars for export, and the smaller coins commanded, in many cases, a still higher price, for use among shop-keepers and small traders. It was easy to see that, unless the weight of our silver coin was reduced, there would soon be none left in the country. Already the eating-houses and drinking saloons had issued their tickets, or shinplaster tokens, in place of coin; and the poor, who purchased the necessaries of life in small amounts, were put to great inconvenience, or obliged to submit to ruinous shaves upon their paper money. To remedy these evils, Congress passed the act of February 21, 1853, (to take effect the 1st of April following) authorizing the coinage of half dollars, quarter dollars, dimes, and half dimes, of a reduced weight, as already stated.

The main source of supply of the precious metals to the mint was, before 1849, from abroad, through the operations of commerce, though the Southern States furnished almost fifteen millions. Since that time, the Pacific slope has been the leading source. The quantity of domestic gold deposited at the mint will be observed on the following page.

The silver currency was not *debased*, in the ordinary sense of the word, the same fineness (nine hundred parts pure silver, and one hundred of alloy) being retained, and the only change in the coin itself being in the weight. The silver dollar, 412½ grains, is now a legal tender to the amount of $50, though previous to 1876 it could only be offered, if objection was made, in sums of five dollars.

The amount of gold and silver used in manufactures and the arts in 1881, was, as nearly as could be ascertained, $13,475,144, of which over 10 millions was in gold. Up to 1840 the amount used in this way was very small, but the increase has been very rapid for the last 20 years. It is estimated that five millions annually would be a fair average since 1840, and this would possibly cover all the previous consumption also. This would add 205 millions of dollars to the amount of the precious metals retained in the country.

The mint operates upon the various forms of the metals brought to it, and these are of great variety, from the most delicate plates and ornaments down to base alloys, and these are all included under the general term bullion, except United States coins. The bullion is either unwrought or manufactured. The first description embraces gold dust, amalgamated cakes and balls, laminated gold, melted bars and cakes. The "dust" is the shape in which it is derived by washing in the placer mines. In South America, Russia and elsewhere, amalgamated gold is that which has been procured by the use of quicksilver, forming a lump. Laminated gold is that which is combined with silver, and derived mostly from Central America. Both these kinds come to the mint in bars and cakes three inches wide, and one and a half thick, weighing 275 ounces, and are worth $5,900. The manufactured is mostly jewelry, plate, and coin. Jewelry is received at the mint in every variety of article into the manufacture of which gold enters. Its value depends upon the quantity of pure gold in it, and this requires to be extracted by assaying. The range of fineness of the better kinds of jewelry is 300 to 600, or from ⅓ to ⅔ the value of coin of the same weight, but the cheaper kinds contain very little gold. All this mass of metal must be reduced to a uniform material, containing the proper proportion of alloy, and cast in bars, 12 in. long, ½ in. thick, and

GOLD AND SILVER OF DOMESTIC PRODUCTION DEPOSITED AT THE MINTS AND ASSAY OFFICES FROM THEIR ORGANIZATION TO THE CLOSE OF THE FISCAL YEAR ENDING JUNE 30, 1881.

| LOCALITY. | GOLD. | SILVER. | TOTAL. |
|---|---|---|---|
| Alabama, | $220,471.97 | ........ | $220,471.97 |
| Alaska, | 31,325.53 | $5.08 | 31,330.61 |
| Arizona, | 2,623,500.50 | 5,761,551.49 | 8,385,051.99 |
| California, | 709,624,600.24 | 2,314,748.72 | 711,939,348.96 |
| Colorado, | 37,332,138.18 | 21,158,446.27 | 58,490,584.45 |
| Dakota, | 10,644,852.78 | 21,276.22 | 10,666,129.00 |
| Georgia, | 7,815,847.52 | 537.98 | 7,816,385.50 |
| Idaho, | 24,683,354.70 | 804,781.96 | 25,488,136.66 |
| Indiana, | 40.13 | ........ | 40.13 |
| Maryland, | 593.06 | ........ | 593.06 |
| Massachusetts, | ........ | 917.56 | 917.56 |
| Michigan (Lake Superior), | 123.99 | 3,477,319.02 | 3,477,443.01 |
| Montana, | 50,141,267.20 | 5,527,897.19 | 55,669,164.39 |
| Nevada, | 15,139,055.96 | 77,435,742.76 | 92,574,798.72 |
| New Hampshire, | 11,020.55 | ........ | 11,020.55 |
| New Mexico, | 1,624,413.02 | 2,483,697.29 | 4,108,110.31 |
| North Carolina, | 10,671,398.29 | 46,016.71 | 10,717,415.00 |
| Oregon, | 16,194,047.73 | 33,684.91 | 16,227,732.64 |
| South Carolina, | 1,419,732.91 | 74.37 | 1,419,807.28 |
| Tennessee, | 85,755.57 | 1.99 | 85,757.56 |
| Utah, | 467,246.58 | 10,288,337.98 | 10,755,584.56 |
| Vermont, | 10,981.27 | 43.50 | 11,024.77 |
| Virginia, | 1,683,436.70 | 30.65 | 1,683,467.35 |
| Washington Territory, | 236,864.36 | 110.96 | 236,975.32 |
| Wyoming, | 723,581.61 | 11,798.00 | 735,379.61 |
| Refined bullion, | 217,364,618.22 | 57,057,970.43 | 274,422,588.65 |
| Parted from silver, | 16,295,800.68 | ........ | 16,295,800.68 |
| Contained in silver, | 9,322,268.97 | ........ | 9,322,268.97 |
| Parted from gold, | ........ | 6,991,451.19 | 6,991,451.19 |
| Contained in gold, | ........ | 526,284.79 | 526,284.79 |
| Other sources, | 10,367,104.26 | 31,955,945.16 | 42,323,049.42 |
| Total, | 1,144,735,442.48 | 225,898,672.18 | 1,370,634,114.66 |

from 1 to $1\frac{1}{2}$ in breadth, according to the size of the coin to be struck. These are tested to see if they are of the legal fineness. They are then annealed, and rolled into long thin strips by means of a steam engine. These strips are then drawn through plates of the hardest steel, to proper thickness, and by a steam press cut into "planchets" or pieces of the exact size of the coin wanted, at the rate of 160 per minute. These are then cleaned, annealed, whitened, weighed, and placed in a tube, which slides them one by one into a steel collar, in which they fit. The piece is seized, stamped with perfect impressions on both sides by the dies, and instantly pushed away to be followed by another piece. The devices on these dies are first cut in soft steel. This "original die" is then hardened, and is used to impress a piece of soft steel, which is then like a coin with the figures raised, and is called a "nub." This being again hardened, is used to impress the dies, with which the coining is done, and a pair of them will do two weeks' work. The coining presses are of sizes proportionate to the work.

# IMMIGRATION.

## CHAPTER I.

### GENERAL MIGRATION—COLONIES AND UNITED STATES.

At the date of the recent national census (1880), about two-fifteenths of the inhabitants of the United States (6,679,943 out of 50,155,783) were of foreign birth, and since that time (to Jan. 1, 1882) 1,313,748 more immigrants have arrived in this country. Of those classed as "natives" in the census, quite as many more are children, one or both of whose parents were foreigners. It may, then, be safely computed that two-sevenths of our population are either of foreign birth or parentage This is irrespective of the large negro element, most of which has been in this country for more than one generation.

The term "native" has been used to distinguish the born citizen from the newly arrived foreigner, as well as the former from the "red man," who was also an emigrant in the view of the lost races that preceded him, and of which monumental traces alone remain in evidence that they ever existed. The history of the human race is a history of migration. Twice has the race comprised only a single family, occupying a single point on the earth's surface, and twice has it spread in all directions, forming nations and founding empires. The antediluvian world was swept away by the deluge, and all traces of the race of Adam had been washed away by the obliterating waters from the earth's surface when the ark gave up its freight. From its door migration was resumed, and three continents owe their populations to the several sons of the patriarch. Asia, Africa, and Europe were settled by Shem, Ham, and Japhet and their descendants, who have stamped their characteristics upon each. From that day to the present, the same recurring circumstances have from time to time produced the same results. As each locality became overcrowded by increase, the most adventurous sallied forth in quest of new homes, which, in their turn, filled, and overflowed into some more distant region. These successive waters rolling on until the remotest shores of each continent were occupied, were succeeded by more formidable hosts of armed invaders, who came, sword in hand, to dispossess occupiers and seize accumulated wealth. With the growth of modern civilization migration has no longer a destructive character. It seeks to build up by bringing industry and aid of natural resources, rather than to destroy by seizing what others have produced. It is more steady and effective in its commercial character—having industry for a means, and prosperity for an object—than in its old form of invasion, plundering by force and leaving desolation in its train.

The British Islands were the last subjects of European incursions. The Britons, originally from N. W. Asia, were plundered by Norse enterprise, and the Saxons alternated with the Danes in dominating the nation after the withdrawal of the Romans, to be in their turn subjected to the Normans. Since then, 800 years have been spent in amalgamating the races and in peopling the islands. Even at that date the adventurous Norsemen had discovered the new continent and formed one or more colonies on the New England coast. It required long centuries, however, in that barbarous age, for the people to struggle successfully against the effects of feudal oppression, civil wars, and their consequences, famine and plague. Nevertheless, progress was made and commerce a good deal developed, when, at the close of the fifteenth century, the discovery of the West Indies by Columbus was followed by an influx of the precious metals into Europe, giving a renewed impetus to industry and enterprise. The Spanish were attracted by gold, and the commercial Dutch by the desire to found colonies, and their example was followed by the English and French. In both these cases, however, the desire of civil and religious freedom was a powerful incentive to the emigrants. These motives were more strongly developed when the English revolution began to operate in the first half of the 17th century. Of the four leading nations that planted colonies on this continent, all were more or less successful. The Spaniards sought gold mainly, but their colonists in Mexico, Central America, New Mexico, California, etc., became rich also in flocks and herds. The French were successful in Canada, but their Louisiana colony was not in any respect profitable. The Dutch maintained their hold on some of the islands, but their colony of New Amsterdam was not well managed, and did not succeed long. The English alone possessed all the requisites for the most perfect success, and they eventually absorbed most of the others.

The disposition to emigrate to America gradually gained ground as the eighteenth century advanced, more particularly in the north of Ireland and Scotland, which already enjoyed the advantage of some intercourse with friends in America. Just before the Revolutionary war, this disposition to emigrate showed itself strongly. The linen weavers in the northern part of Ireland were, by the decline in that trade, induced to migrate. For two years, 1771 and 1772, sixty-two vessels left with eighteen thousand passengers for America, paying passages of $17.00 each. Most of these were linen weavers and farmers, possessed of property, and they carried with them so much money as to attract the notice of the government. The movement, however, continued in 1773 and extended itself to the north of Scotland, whence the highlanders migrated in great numbers. Knox, in his view of the British empire at that time, asserts that in the twelve years ending in 1775, about thirty thousand highlanders emigrated, exclusive of the lowlanders; and it was compute' that there were sixty thousand highlanders, citizens of the United States in 1799. In the report of the committee on the linen manufactures in the Irish Parliament in 1774, it is stated that the whole emigration from the province of Ulster was estimated at thirty thousand people, of whom ten thousand were weavers, who, with their tools and money, departed for America; thus adding to the numbers and wealth in the new world, in the proportion that the British Islands lost from the same cause.

The breaking out of the War of Independence, naturally interrupted the communication between America and the old world; but with the return of peace, in 1783, the migration revived, notwithstanding the incredible hardships which at that time attended the transit. The shipping was little adapted to the trade, and no special laws protected the rights of the poor emigrant. As an instance of this, it is related that in September, 1784, a ship left Greenock with a large number of passengers, who had paid twenty-five dollars each for their passage. They were robbed of their chests and provisions by the master, and one hundred of them turned ashore on the Island of Rathlin, coast of Ireland. Another vessel rescued seventy-six emigrants from a desert island, where they had been turned adrift by the master of a brig, who had engaged to carry them from Dunleary, in Iceland, to Charlestown. In the same year there were great numbers landed at Baltimore, Philadelphia, and elsewhere. Blodgett's Statistical Manual, published in 1806, states that from 1784 to 1794, the arrivals were four thousand per annum. In the year 1794, ten thousand persons were estimated to have arrived in the United States. Adam Seybert, a member of the House of Representatives, in his "Statistical Annals," admitting the number for that year, states that so large a movement did not again occur until 1817.

When the colonies separated from the mother country, the population of the latter was, for England and Wales, 7,225,000, and about 2,000,000 for Ireland, making together 9,225,000 souls, or less than one-sixth the present inhabitants of the United States. The population of the newly-formed United States in the year 1790 was 3,174,-167 whites, or about one-third the numbers in England and Ireland. The founders of the nation were then not unmindful of the fact that these three millions of people, occupying 163,746,686 acres of land although possessed of a vast territory, had little else to depend upon. Capital was scarce, and manufactures had not been permitted under imperial rule, hence skilled artisans were not to be found. While all these things were indispensable to the new country, crowds of poorly paid and oppressed operatives on the other side of the Atlantic were impatient to enjoy the privileges that our new form of government held out to them. The French, German, and English troops, that returned home after the war, had not only left a portion of their numbers here as settlers, but had carried home favorable reports of the advantages to be here enjoyed. It was manifestly to the interest of the new government here to invite and encourage these settlers, at the same time to guard against possible political abuse of the privilege. The new Constitution therefore required Congress to pass uniform laws for naturalization. This was not done until April 14th, 1802, when the regulations that have since mainly continued were enacted. By that law, those aliens who were in the country prior to 1795 might be admitted to citizenship on proof of two years' continuous residence in the United States, sustaining a good moral character, and abjuring allegiance to foreign nations. Any alien arriving in the United States after the passage of the act was to comply with the following conditions:

1. He shall, before some competent court, swear, at least three years before his admission, that it is his *bona fide* intention to renounce forever all allegiance to any sovereign state to which he was a subject.

2. He shall swear to support the Constitution of the United States.

3. Before he can be admitted he must show that he has resided within the United States five years, and within the jurisdiction of the court one year. He must also show that he has been of good moral character, and well disposed to the happiness of the United States.

4. He must renounce all titles of nobility. The law of March 3, 1813, required that the residence of five years should have been continuous in the United States. This restriction was repealed Jan. 26, 1848. The law of May 26, 1824, reduced the term of notice of intentions from three to two years. These were the chief regulations of the federal government in relation to naturalization. Many of the states have, however, from time to time, passed laws relative to immigrants, importation of paupers, convicts, lunatics, etc. New York and many other states have had laws requiring of the owner, or master, or consignee of the passenger ship, a well-secured bond to the people of the state against loss for the relief or support of such passengers. In lieu of this bond, commutation money might be paid.

The federal government having smoothed the way, the migration proceeded until unfriendly relations between the United States and Great Britain, growing out of the wars of Europe, checked intercourse. The claim enforced by Great Britain of the principle, "Once a subject always a subject," served to take from emigrants the security they sought under the American flag; and in 1806 Great Britain declared France in a state of blockade, and France retorted upon the British Isles. These proceedings being succeeded by others, compelled the United States, in 1809, to prohibit intercourse with France and Great Britain. In 1810 Napoleon annulled his decree, but Great Britain continued her vexations, seizing American seamen, and riding rough-shod over their rights. The embargo was then succeeded by the war of 1812, during which migration was very limited. In February, 1815, peace was concluded, and the stream of migration, long pent up, resumed its flow with greater force. The accommodation was, of course, limited, and the more restrained that a law of Parliament restricted the number that might be carried to the United States to one for every five tons, although one for every two tons might be carried to any other country. In the year 1817, 22,240 persons arrived in the United States, including Americans who returned home. This large migration was attended with immense suffering. The attention of Congress was called to it, and a law was passed, March 2, 1819, to regulate the transportation of passengers. This act limited the number to two for every five tons of measurement, and provided for an ample allowance of food and fuel. When the famine of 1846–7 gave a new impulse to the movement, more complete laws were found requisite, and a number were passed. March 3, 1857, the present passenger act was enacted, repealing all former laws upon the subject, which with some slight modifications since made, establishes the regulations now in force. It regulates the space for each passenger, the number of berths, ventilation and warming, and the kind and quantity of food to be furnished by the ship and how it is to be dealt out, and if any passenger is put on short allowance, the master or owner shall pay him three dollars each day of short allowance.

The first accounts of the numbers of immigrants commenced in 1820, under the law of 1819. The following table shows the number of emigrants for fifty years.

THE NUMBER OF ALIEN PASSENGERS ARRIVED IN THE UNITED STATES FROM FOREIGN COUNTRIES, FROM THE COMMENCEMENT OF THE GOVERNMENT TO THE 31ST OF DECEMBER, 1881. THE DATES ARE INCLUSIVE.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Prior to 1820 | 250,000 | 1835 | 45,374 | 1851 | 379,466 | 1867 | 298,358 |
| 1820 | 8,385 | 1836 | 76,242 | 1852 | 371,603 | 1868 | 297,215 |
| 1821 | 9,127 | 1837 | 79,340 | 1853 | 368,645 | 1869 | 395,922 |
| 1822 | 6,911 | 1838 | 39,914 | 1854 | 427,833 | 1870 | 378,796 |
| 1823 | 6,354 | 1839 | 68,069 | 1855 | 200,877 | 1871 | 367,789 |
| 1824 | 7,912 | 1840 | 84,066 | 1856 | 200,036 | 1872 | 449,483 |
| 1825 | 10,199 | 1841 | 80,289 | 1857 | 250,887 | 1873 | 437,004 |
| 1826 | 10,837 | 1842 | 104,565 | 1858 | 123,877 | 1874 | 277,593 |
| 1827 | 18,875 | 1843 | 52,496 | 1859 | 121,075 | 1875 | 209,036 |
| 1828 | 27,382 | 1844 | 78,615 | 1860 | 153,640 | 1876 | 182,027 |
| 1829 | 22,520 | 1845 | 114,371 | 1861 | 91,822 | 1877 | 149,020 |
| 1830 | 23,322 | 1846 | 154,416 | 1862 | 91,826 | 1878 | 174,688 |
| 1831 | 22,633 | 1847 | 234,968 | 1863 | 176,214 | 1879 | 272,487 |
| 1832 | 60,482 | 1848 | 226,527 | 1864 | 193,416 | 1880 | 6[illegible]2,250 |
| 1833 | 58,640 | 1849 | 297,024 | 1865 | 248,111 | 1881 | 743,777 |
| 1834 | 65,365 | 1850 | 369,980 | 1866 | 318,491 | | |

Of the immigrants who landed on our shores in the *sixty-one years* ending with Dec. 31, 1881 (1820 to 1881) there came from different countries as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Gt. Britain & Ireland. | 5,025,796 | Russia and Poland,. | 60,313 | Belgium, | 94,422 | Asia not specified,. | 616 |
| France, | 311,243 | Switzerland, | 96,541 | Denmark, | 58,606 | Dom. of Canada,.. | 738,231 |
| West Indies, | 78,180 | China, | 225,431 | Portugal, | 7,604 | Central America,... | 1,487 |
| Sweden and Norway,. | 443,151 | Germany, | 3,317,320 | Turkey, | 664 | Australia, etc., | 20,674 |
| South America, | 9,326 | Holland | 54,392 | Greece, | 379 | All other countries, N. E. S., | 381,983 |
| Africa, | 866 | Mexico, | 24,402 | Austro-Hungary,.... | 125,816 | | |
| Spain, | 26,795 | Italy, | 92,656 | Japan, | 366 | Total 61 years, | 11,686,235 |

Of those arriving here from Jan. 1, 1820, to Dec. 31, 1881, those wholly or mainly speaking English were from

| | | | |
|---|---|---|---|
| Great Britain and Ireland, | 5,025,796 | Azores and African Islands | 9,174 |
| British North America, | 738,231 | Africa, | 866 |
| English West India Islands, | 1,664 | | |
| Australia and adjacent Islands, | 20,674 | Total of English Speech, | 5,836,405 |

Of races mainly Teutonic or Scandinavian, there were from

| | | | | | |
|---|---|---|---|---|---|
| Germany, | 3,317,320 | Switzerland, | 96,541 | Of Sclavic races, | 60,373 |
| Austro-Hungary, | 125,816 | Denmark, | 58,606 | | |
| Holland, | 54,392 | Sweden and Norway, | 443,151 | Total, | 4,191,166 |
| Belgium, | 94,422 | Iceland, | 605 | | |

Of French, Spanish, Portuguese, and Italian races, there were from

| | | | | | |
|---|---|---|---|---|---|
| France, | 311,243 | Central America, | 1,487 | Miquelon, | 3 |
| Spain, | 26,795 | South America, | 9,326 | Corsica, | 13 |
| Portugal, | 7,604 | West Indies, | 78,180 | | |
| Italy, | 92,656 | Cape Verde, Madeira, and Canaries | 1,310 | Total, | 553,013 |
| Mexico, | 24,402 | | | | |

Of Asiatic and Polynesian races, there were from

| | | | |
|---|---|---|---|
| China, | 225,431 | Turkey, | 664 |
| Japan, | 366 | Greece, | 379 |
| The rest of Asia, and the Asiatic Islands, | 618 | Countries not specified, | 381,983 |
| Polynesia, | 483 | | |
| African Nations, | 866 | Total, | 610,790 |

Numbers of those who come from other countries, as France, West Indies, and Southern Europe, as well as to some extent from England, are merchants and travelers, who are not to be embraced in the aggregate of settlers in new homes. The great sources of migration are, then, British, German, and Scandinavian. The Swede and the Norwegian are free in their choice, and since 1860, have emigrated to this country in large numbers, settling mainly in Iowa, Wisconsin, Minnesota, Kansas, and Nebraska. Many of them also enter into domestic service in our large cities. The Swiss are to a considerable extent free and thrifty in their mountain homes, but great divisions exist in respect of religion as well as politics, and there is among them a want of nationality. The cantons of Vaud and Geneva are mostly French, and threaten to become quite so. On the side of the Tyrol the Swiss become Italians. The German Swiss are mostly connected with Baden, and are embraced in the German movement. The Hollanders migrate to some extent, and often from motives of religion. The Moravian Brethren thus founded colonies in Pennsylvania. Gold seems, since its discovery in California, to have stimulated Dutch enterprise. The French are markedly attached to their native soil and national character, and colonize little; they migrate but moderately. Even Algiers has grown but very slowly under thirty years of governmental fostering care, and there are now but 60,000 French in the colony. Of those French who arrived in the United States up to 1880, over 40 per cent. remained in the country according to the census.

Within a few years past there have been added to these large numbers of Mennonites, who, though coming hither from Russia, from whence they have been driven by the Russian government, because they would not perform military duty, are mostly of German origin, and emigrated to central and southern Russia on the express condition that they should not be required to perform military service, to which they were conscientiously opposed. They have considerable affinity with the Friends and Dunkers, or Dutch Baptists, in their religious customs. They are mostly farmers, are industrious, intelligent, and peaceful, and make excellent citizens. With them have come in moderate numbers Russian dissenters, known as Molokans or Milk-Drinkers, who are also sufferers for conscience sake. These two classes of immigrants have settled largely in Dakota, Nebraska, and Kansas, and a few have located their farms in Manitoba, but for some cause do not seem satisfied there.

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## CHAPTER II.

### EUROPEAN MIGRATION—FRENCH AND GERMAN—NEW TRADE.

The peace of 1815, in re-establishing the liberty of the seas, so long suppressed, opened new countries to European commerce. On the other hand, many interests underwent adverse changes; numerous armies were newly disbanded, and great numbers of men were forced to leave home in search of a useful application of their talents and energies. America was to them the chief point of attraction; those who knew only the trade of arms, offered their swords to the Spanish colonies then fighting for emancipation. Of these a majority found early graves from excess, fatigue, and misery; many turned their attention to agriculture, and the wisest sought refuge in the United States, where services were well requited, and the broad territories offered a limitless field for activity. At first the emigrants were isolated individuals; soon entire families went in quest of new homes, and their success was a tempting example to other families, each of whom drew others in their train, until a continuous movement was established from the valley of the Rhine to America.

This developed a new era in the international commerce. The cotton of the southern states had up to that time found a limited market in Havre, but being carried thither in American ships, there being little return freight for those vessels, the cotton was charged with freight both ways, out and home. The moment that considerable numbers of passengers offered themselves for the return, that trade of itself became an object, affording a profitable home freight. It was then apparent that the light and elegant models of the American ships, which had so well answered the purpose of speed and efficiency during the war, were not adapted to the transportation of passengers. A different style of construction was needed,allowing of greater stowage of cotton out, and better accommodation to passengers, in accordance with the provisions of the law prescribing the room to be allowed to each passenger. This change causing greater attractions to the American ships, drew increasing crowds from the valley of the Rhine across France to Havre. Many of these poor people could raise only the sum needful for the passage, and depended upon begging their way across France to the port. These crowds of beggars alarmed the government, and it took measures to stop them. It was ordered that no one should be admitted to cross France unless he had previously paid his passage in the ship, was possessed of $150 for every member of the family over eighteen years of age, and had his passport signed by the French embassador at Frankfort. The effect of these absurd regulations was to destroy the trade of Havre, and turn the migration down the Rhine to Antwerp, Bremen, and Hamburg. The Havre merchants made great efforts to remedy the evil by sending agents to aid the emigrants, lending them the money to pass the frontier, and to be returned immediately after. A great rivalry was thus engendered between the northern ports and Havre, which still had great advantages in respect of the number of American vessels that arrived with cotton, and finally the obstacles interposed by the government were removed. The city of Bremen was prompt to take advantage of the error of the French government, and used every effort to attract the emigrants to that port, by granting facilities and protecting them from imposition. A law was passed regulating in the most minute particular the accommodations to be given to emigrants on shipboard. They are not to be taken on board until the moment of departure. To accommodate them prior to shipment, an immense building was constructed to hold 2,000 people; it has a front of 200 feet, and is 100 in depth. It has public rooms, sleeping apartments, kitchens, baggage-rooms, etc., and is warmed by steam throughout. There are also chapels for catholic and protestant worship, and a hospital, with thirty-three beds. The price charged with board is fourteen cents per day. By these and other means Bremen has acquired a large share of the emigrant business. Hamburg did not at first make the same efforts; of late years societies for the protection of emigrants have been formed there.

The Germans formerly preferred to embark at Havre, Southampton, or Liverpool, and on American ships, to sailing from German ports and on German ships; but a change has taken place in this respect of late years. The German steamers, of which there are now eight or nine lines, are much better than formerly, and having good steerage accommodations, make the passage in 12 or 13 days. The French steamships do not carry emigrants, and as a result of the late war, there are few American steamers running regularly to Europe. Emigration by sailing vessels is seldom attempted now, and only by the lowest class of emigrants. There are numbers who go from Rotterdam, Ostend, or Hamburg, to England, and depart thence to their final destination. From Bremen the emigrant ships go to a greater variety of ports than from Havre. The United States is, however, the ultimate destination of nearly all.

The motives that impel German migration are variously understood. The reports of the numerous emigration societies give evidence of the highest traits of character. The German is described as a persevering worker, seeking to ameliorate his condition. He is always ready to go where his services will be the best paid, and certain professions have long been pursued by him in all countries. If his feeling of nativity is strong, his love of family is still stronger. And, moreover, the Teutonic race may now be said to be at home on half the entire globe. There are, however, other motives, and these are evidently the desire to find civil, political, and religious liberty, of which they have not the perfect enjoyment at home. The Germans have never succeeded in founding colonies of their own under good government, but they are a valuable acquisition where others have established liberty and order. They do not seek exemption from military service, and in the late civil war the German regiments fought bravely and persistently. They are generally good and law-abiding citizens, thrifty and industrious, and kind and helpful to the poor. There are two objections urged against them, and with some justice, viz., that they are addicted to beer-drinking, and that they make Sunday a boisterous and noisy holiday.

While Germany was divided into many petty states, their division, which materially checked industry and increased the taxation, was itself an exceedingly strong incentive to emigration; and before their confederation into one government was fully accomplished, almost every family had its representatives here, and the tendency had become so strong for a home in the "land of promise," that no political changes could greatly affect it.

The German governments have all, more or less, occupied themselves with the question of migration, and in some cases have sought to check it. Among these attempts was that by Prussia to found agricultural colonies. The king offered lands in the duchy of Posen, and agents were sent among the emigrants from the valley of the Rhine. The conditions were, that the settlers should not leave the country without permission, and never without having performed military service.

These, it may be supposed, were without success. Emigrant agents are, by some governments, required to submit to regulations; sometimes the number is limited, and sometimes they must give security. In Bavaria only two houses are authorized to treat with emigrants for their passages across France, and the contracts must be inspected by the consul at Havre. There results a large clandestine emigration to avoid these restrictions, and at the frontiers numerous agents are ready to assist — a sort of underground railroad. The governments of Wurtemberg, Baden, and the two Hesses, are less rigorous, but nowhere can passports be obtained until every effort has been made to dissuade the emigrant. In case he persists, he must renounce all rights of citizenship and nationality. On the other hand, measures are taken to aid the emigrant. When the cause of departure is destitution, the communes and the government subscribe, while stipulating that the emigrant shall renounce all right to ulterior aid. All the persons so aided go from one canton together. When the emigrants pay their own expenses and have a small capital, bands of numerous families from divers points assemble and depart together. Political exiles are very few, but these have generally considerable means.

It is melancholy, however, to reflect in how great a degree destitution becomes the cause of migration. Singularly enough, the valley of the Rhine, of which the German poets sing the beauty and the fertility, is precisely the spot, of all Europe, where the misery of Ireland is most nearly reproduced. From the Lake of Constance to the frontiers of Holland, that famous valley has so long felt the oppression of feudalism and been the battle-field of contending powers, as to have become completely impoverished. In the duchy of Baden the day's wages of a skilled workman is twenty-eight cents—a sum which may sustain life in a year of good harvest, but which is utterly insufficient in time of dearth, as in 1846, when potatoes became diseased. The insurrection of 1849 added to the calamities, and in 1852, of a population of 1,356,943 souls, 14,400 emigrated, or one per cent in one year. The thrift and endurance of the Germans are well developed in a land of such hardships, and on their arrival in the United States they are not slow in turning their persevering industry to account. It is singular that the distress and destitution which centuries of misrule have produced in Ireland, so famed for its natural advantages, should be reproduced in Europe only in the Rhine valley, the garden of Europe. The two localities best endowed by nature are precisely those where man is most anxious to escape by migration from an accumulation of miseries. The migration from Germany, though fluctuating somewhat with the harvests, shows a considerable increase in every term of five years. In 1881, it was 249,572; more than in any previous year. There are considerable numbers who go, by other conveyance from Bremen, etc., than the emigrant ships, to Liverpool, and embark thence for America. This aggregate German movement has come of late years to rival, and often to exceed the broad stream of British migration. The migration from Great Britain has always been largest in the years of dear food, and it has again subsided when good harvests have diminished the prices of bread. The number that went abroad in 1843 was 57,212, and it continued to augment year by year until it reached 368,764 in the year 1852. Several causes concurred to produce this increase. The first was the famine of 1845–46–47, and the consequent means adopted by the British government for the relief of Ireland; the second was the gold fever, which carried off thousands; and the third was the prosperity of the emigrants in the United States, where railroad building and other employments gave the means to send for friends in unusual numbers. The most important cause was, probably, the condition of Ireland. The conquest of that country, which was commenced seven centuries since, is but now being completed. We now see the insubmissive Celts quitting, with the aid of their conquerors, the disputed country, to seek new homes beyond the seas. They cannot assimilate to the conquering race, and not being able to defend themselves, they abandon the country rather than submit. During all the time of religious persecution, from the reign of Henry VIII. to George III., the economical condition of Ireland was deplorable, and misery made incessant progress. The landed population became involved in debt, and a fatal subdivision of the land was introduced in the mode of culture. Farms were subdivided as fast as the people multiplied, which was fully equal to the proverbial fecundity of a state of extreme poverty, and the potato came to be the sole dependence of all for food. The sudden destruction of that dependence by rot was an overwhelming calamity, that brought matters to a crisis. It was felt that migration could not remedy the evil, but that a radical change in a wrong system was become indispensable. The system pursued had been for the landlords, mostly in debt, to absent themselves altogether. The land was then taken by "middle men," at a rate which hardly met the interest on incumbrances. This land was then parcelled out to the poor cotters in lots down to one-fourth acre or less, mere patches, at rates which gave a large aggregate rent to the "middle man." Those patches were planted with potatoes, which were the sole dependence of the family for food in the year. They were gathered, when ripe, into a pile, and that pile diminished by daily consumption until an approaching new crop found it exhausted. The supply of food for the year depended entirely upon the amount of the crop. Its yield was the sole dependence of the family to sustain life. The cotter had no property or capital of any kind to be made available in case of emergency. His only means of paying rent was an annual migration to England in harvest time to earn the necessary sum. That done, the balance of the year was idly spent in watching the sinking pile of potatoes. It may well be imagined how great was the horror that seized such a people when the sole barrier between themselves and starvation was found rotten, suddenly perishing under their eyes. The scenes that followed were awful to contemplate. All that could, fled, and these were mostly the robust males, leaving the infirm, the old, and the young to encounter the slow death that was gradually approaching, and which overtook multitudes. The greatest efforts were made by the British government to purchase and distribute food, and to employ hands upon roads. At one time over 500,000 were so employed. The introduction of the Indian corn was attempted as a substitute; but it was nearly impossible amid a people entirely ignorant of its use. Hand-mills were furnished to grind it, and the priests and others used great exertions to teach them to cook it. It was frequently the case, however, that the grain did not agree with the people, but exhibited poisonous effects on being eaten. The body swelled, and severe illness ensued. Migration and famine did its work in spite of all efforts of humanity, and the census of 1851 showed how awful had been the havoc.

The population of Ireland has been as follows, per official reports:—

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|---|---|---|---|
| 1821, | 6,801,827 | 1861, | 5,850,309 |
| 1831, | 7,767,401 | 1871, | 5,402,759 |
| 1841, | 8,222,664 | 1881, | 5,159,839 |
| 1851, | 6,623,984 | | |
| Decrease from 1841—40 years, | | | 3,062,825 |

In the ten years ending with 1831, the increase was one and a half per cent. per annum. From that date to 1841 it was nine-tenths of one per cent, and that was a period of much comparative prosperity. The crops were still good, and the failure of the English wheat crops in 1837 raised the prices of Irish grain, and gave much employment to its agriculturists. If it had continued the same rate up to 1847, the famine year, the population would then have been 8,616,680 souls, when the migration took place in large numbers, and continued the succeeding thirteen years down to 1859. The same increase in that thirteen years would have made the population 9,651,678 persons, or as follows: —

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|---|---|
| Population in 1841 | 8,175,124 |
| Ten years' increase at 9 per cent | 735,761 |
| The population should have been in 1851 | 8,910,885 |
| Actual population | 6,553,291 |
| Loss by famine and migration | 2,357,594 |
| Number emigrated | 1,422,000 |
| Population in 1851 | 6,623,982 |
| Ten years' increase at 9 per cent | 595,500 |
| The population should have been in 1861 | 7,148,791 |
| Actual population | 5,850,309 |
| Loss by migration, etc | 1,298,482 |
| Number emigrated | 1,972,499 |

In the famine years, up to 1851, 935,594 persons disappeared more than were accounted for by migration. From 1851 to 1861, there migrated 674,017 more persons than should have been lost by the census. The numbers who have returned were for a time, it is known, upwards of twenty thousand per annum, and these carried back much larger sums than they brought with them.

In this view the emigration reacted upon the northern states, the emigrants carrying off all that they have created. The whole operation above was as follows for fifteen years:—

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| Population in 1847 | 8,616,680 |
| Population in 1861 | 5,850.309 |
| Decreased | 2,766,371 |
| Emigrated | 3,393,499 |
| Excess | 372,872 |
| Carrying forward the estimate, the population in 1881 was | 5,850,309 |
| Ten years' increase at 9 per cent | 526,527 |
| The population should have been in 1871 | 6,376,836 |
| Actual population | 5,402,759 |
| A loss by migration, etc., of | 974,077 |
| Carrying forward the estimate, the population should have been in 1881 | 5,889,007 |
| It was | 5,159,839 |
| A loss in the decade of | 729,168 |

Whitaker's English Almanac for 1882 states that the actual emigration from 1851 to 1881 has been 2,637,187.

The first reformatory efforts of the English government were to throw the support of the Irish poor upon the parishes, and as the tax became onerous the forced sale of the encumbered estates was authorized. The two measures have succeeded. The land has passed into thrifty hands; the bankrupt landlord is dispossessed, and the extortionate "middle man" is abolished; and the excessively poor population has been purged off by migration. The "clearing of the lands" was in many cases conducted with much barbarity. The little huts of the peasants were pulled or burned down, and the hapless people driven forth to seek homes beyond the seas as they best could. In other cases the landlords, the government, or societies furnished the means of shipments. The government soon found the necessity of interposing by law, as the United States had done, to protect them from the rapacity of shippers and their agents. The law of 1849 was passed with that object. By its provisions no ship shall carry more than one person for every two registered tons; nor shall there be more than one person for every twelve superficial feet on the main deck and below it. The size, number, and construction of the berths are regulated, and the captain is required to issue food as follows to each person twice a week:—

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|---|---|
| Bread | 2½ lbs. |
| Wheat Flour | 1 " |
| Oatmeal | 5 " |
| Rice | 2 " |
| Tea | 2 oz. |
| Sugar | ½ lb. |
| Molasses | ½ " |

A surgeon must be carried where there are one hundred or more passengers, and many other regulations that experience has pointed out as necessary, are enforced upon the carriers. The food is to be furnished entirely irrespective of the price of the passage, which fluctuates almost daily between $16 and $24 each adult, and half price for children. The starving and destitute race each year sends forth crowds from all parts of Ireland to embark at Liverpool. The means are mostly furnished by Irish in America, who consider it their duty to appropriate their first earnings in their new homes to the rescue of their relatives, and small remittances, aggregating millions in a year, find the way into every cabin and workhouse as messengers of life to the despairing. Those poor people, once started on their travels, encounter numerous perils before reaching their destination. As soon as a party of emigrants arrives in Liverpool, they are beset by a tribe of people, both male and female, who are known by the name of "man-catchers" and "runners." The business of these people is, in common parlance, to "fleece" the emigrant, and to draw from his pocket, by fair means or by foul, as much of his cash as he can be persuaded, inveigled, or bullied into parting with. The first division of the man-catching fraternity are those who trade in commissions on the passage money, and call themselves the "runners" or agents of the passenger brokers. The business of the passenger broker is a legitimate and necessary one. Under the passenger act of the 12th and 13th Victoria cap. 3, the licenses of all the passenger brokers expired on the 1st of February, 1850, subject to renewal after their being approved of by the government emigration agent, and to their entering into bonds, with two sureties, in the sum of $1,000, for the due fulfilment of all the requirements of the act of Parliament relating to the comfort and security of emigrants. The passenger brokers at Liverpool, in common with the unwary and unsuspecting emigrants, have suffered greatly from the malpractices of the "runners," who pretend to be their agents. These man-catchers procure whatever sums they can from emigrants as passage money—perhaps $25 or $30, or even more—and pay as little as they can to the passenger broker, whose business they thus assume—often as little as £3, or £3 5s. In addition to these large and knavish profits, they demand a commission of seven and a half per cent. from the passenger broker, and they have been often known to obtain and enforce this commission, although their whole concern in the matter may have been to watch the number of emigrants going into or coming out of the brokery office, and to put in a claim for having brought or "caught" them.

To form an idea of the sums paid in any one year as commission to the man-catchers, in the item of passage money, we have but to take the total steerage emigration of that year and multiply it by £3 10s., or seventeen dollars—the average amount of passage money—and calculate what a per-centage of seven and a half per cent. would amount to. The total steerage emigration of 1859 was one hundred and forty-six thousand one hundred and sixty-two souls, which, at seventeen dollars a head, would amount to no less than two million four hundred and eighty-four thousand seven hundred and fifty-four dollars, on which, taking the commission at the low rate of six per cent., they draw one hundred and forty-nine thousand and forty dollars, which is generally stated to be about the sum actually paid to this particular class of people, on the average of the last three years, by the passenger-brokers of Liverpool. But these are not the only class of the man-catching fraternity, nor do they confine their operations to an exorbitant profit upon passage money. The man-catchers keep lodging-houses for emigrants—wretched cellars and rooms, destitute of comfort and convenience, in which they cram them as thickly as the place can hold. The extra profits they draw from this source cannot be inferior in amount to their previously mentioned gains, and the cherished hoards of the poor pay a large percentage to their unscrupulous rapacity.

In addition to this trade, some of them deal in the various articles composing the outfit of emigrants, such as bedding, clothes, food, cooking utensils, and the nick-nacks of all kinds which they can persuade them to purchase. Some of the store-keepers in this line of business pay their "runners" or "man-catchers" as much as ten per cent. commission on the purchases effected by the emigrants, from which the reader may form some estimate of the enormous plunder that must be drained from the poor ignorant people. As every emigrant must provide his own bedding, the sale of mattresses, blankets, and counterpanes, enters largely into this trade. After the bedding is provided, the man-catchers, who are principally Irishmen themselves, and know both the strength and weakness of the Irish character, fasten upon their countrymen—many of whom, poor and miserable as they look, have sovereigns securely stitched amid the patches of their tattered garments—and persuade them into the purchase of various articles, both useful and useless. Among these may be mentioned clothes of all kinds—shirts, trowsers, waistcoats, shawls, petticoats, south-westers, caps, boots and shoes, slippers, cooking utensils, cans for the daily allowance of water, and tins to hold their meal, rice, and sugar. Provisions, such as bacon, herrings, salt beef, and other articles not found them on board, and luxuries, in which whiskey and tobacco are generally included, come next on the list, after reiterated assurances from the man-catchers that no emigrant will be taken on board without them. These being provided, and an Irishman being easily squeezeable, when a friend and a countryman is the man-catcher who has him in hand, and when he fears that his passage-money will be lost for non-compliance with the regulations, his attention is next directed to such articles as pocket-mirrors, razors, bowie-knives, pistols, telescopes, etc.

The stranger in Liverpool, who takes a walk in the immediate vicinity of the Waterloo Dock, whence the greater number of emigrant vessels take their departure, will see a profuse display of the various articles upon which the man-catcher makes his gains—articles generally of the most inferior quality, and sold at the most extravagant and ridiculous prices. The man-catching business, in all its various departments, has been reduced to a regular system, and no London sharper can be more sharp than the Liverpool runners. Perhaps the most complicated and ingenious trick is the following: When a steam-vessel laden with emigrants leaves an Irish port for Liverpool, one of the Liverpool fraternity, dressed up as a raw Irishman, with the usual long-tailed, ragged, and patched gray frieze coat, the battered and napless hat, the dirty unbuttoned knee-breeches, the black stockings, the shillelah, and the short pipe, takes his place among them, and pretends to be an emigrant. Before the vessel arrives at Liverpool he manages to make acquaintance with the greater portion of them, learns the parish they came from and the names of the relatives whom they have left behind, not forgetting those of the parish priest and the principal people of the neighborhood. He also ascertains the names of the friends in America whom they are going to join. He tells them of the roguery of Liverpool, and warns them against thieves and man-catchers, bidding them take especial care of their money. On arriving at the quay, in Liverpool, he jumps ashore among the first, where a gang of his co-partners are waiting to receive him. He speedily communicates to them all the information he has gained, and the poor people on stepping ashore are beset by affectionate inquiries about their friends in Ireland, and that good old man the parish priest. They imagine that they have fortunately dropped among old acquaintances, and their friend of the steamboat takes care to inform them that he is not going to be "done" by the man-catchers, but will lodge while at Liverpool at such and such a place, which he recommends. They cannot imagine that men who know all about the priest and their friends and relatives can mean them any harm, and numbers of them are usually led off in triumph to the most wretched but most expensive lodging-houses. Once in the power of the man-catchers, a regular siege of their pockets is made, and the poor emigrant is victimized in a thousand ways for his passage money, for his clothes and utensils, and for his food. Even after they have drained him as dry as they can, they are loth to part with him entirely, and they write out per next steamer a full, true, and particular account of him—his parish, his relations, his priest, and his estimated stock of money—to a similar gang in New York. Paddy—simple fellow—arrives in New York in due time, and is greeted on landing by the same affectionate inquiries. If his eyes have not been opened by woeful experience, he thinks once more that he has fallen among friends, and is led off by the "smart" man-catchers of the New York gang, to be robbed of the last farthing that he can be persuaded to part with; and he is possibly induced to spend the savings of years in the purchase of land, supposed to be in the far west, but having no other existence but such as paper and lies can give it.

It must not be supposed, from the statements in reference to the rogueries practised by runners and man-catchers upon the simple, emigrants themselves do not occasionally endeavor to commit frauds, both upon each other and upon the owners and captains of ships. The Irish emigrant, with the passion for hoarding which is so common among his countrymen, often hides money in his rags, and tells a piteous tale of utter destitution, in order to get a passage at a cheaper rate. The shameless beggary, which is perhaps the greatest vice of the lower classes of Irish, does not always forsake them, even when they have determined to bid farewell to the old country; and I have several times been accosted by men and women, on board emigrant ships in dock, and asked for contributions to help them when they got to New York. "Sure, yer honor, and may the Lord spare you to a long life; I've paid my last farden for my passage," said a sturdy Irish woman, with a child in her arms, when accosted on the quarter-deck of a fine ship, in the Waterloo Dock, "and when I get to New York I shall have to beg in the strates, unless yer honor will take pity on me." On being asked to show me her ticket, she said her husband had it; and her husband—a wretched-looking old man—making his appearance and repeating the same story, was pressed to show the document. He did so at last, when it was apparent that he had paid upwards of seventeen pounds—eighty-two dollars and twenty-five cents—for the passage of himself and wife and his family of five children. "And do you mean to say that you have no money left?" was inquired of him. "Not one blessed penny," said the man. "No, nor a fardin," said the woman, "and God knows what'll become of us." "Do you know nobody in New York?" "Not a living sowle, yer honor." "Have you no luggage?" "Not a stick or a stitch, but the clothes we wear." As the good ship was detained two days beyond her advertised time of sailing, all the emigrants, as usual, had liberty to pass to and from the ship to the streets, as caprice or convenience dictated. On the following day, this sturdy woman and her husband were seen entering the Waterloo Dock gates with a donkey-cart, tolerably well piled with boxes, bedding, and cooking utensils. When they were down in the steerage, and she was asked whether that was her luggage, she replied it was. "You said yesterday, however, when you were begging, that you had no luggage." "Sure, it's a hard world, yer honor, and we're poor people—God help us."

An incident of a kind not very dissimilar occurred on board of another American liner. When the passenger roll was called over, it was found that one man, from the county of Tipperary, had only paid an instalment upon his passage money, and that the sum of $6 each for three persons, or $18, was still due from him. On being called upon to pay the difference, he asserted vehemently that he had been told in the broker's office that there was no more to pay, and that to ask him for more was to attempt a robbery. The clerk insisted upon the money, and showed him the tickets of other passengers to prove the correctness of the charge. The man then changed his tone, and declared that he had not a single farthing left in the world, and that it was quite impossible he could pay any more. "Then you and your family will be put on shore," said the clerk, "and lose the money you have already paid." The intending emigrant swore lustily at the injustice, and declared that if put on shore he would "get an act of Parliament" to put an end to such a system of robbery. The clerk, however, was obdurate, and the man disappeared, muttering as he went that he would have his "act of Parliament to punish the broker, the clerk, and the captain." He returned in a few minutes from below, and, without saying a word of what had happened, and looking as unconcerned as a stranger, coolly presented a £5 note, or $24 25, and asked for his change. Such is a specimen of the rogueries attempted by those who have money. Those who really have none at all, or who possibly have not sufficient to pay their passage, resort to other schemes for crossing the Atlantic at a reduced rate, or free of charge altogether, and "stow away." This is a practice which is carried on to a great and increasing extent.

After encountering these perils of poverty and cheating, the crowd becomes finally located on board of ship, and assigned their quarters for the voyage. It is a strange place for the new-comers, and their admiration of the new life they have entered upon begins with the first day's issue of regulation food. The experience of most of them in the edible way, has hitherto been confined to "murphys" or, at most, Indian meal, which they heartily detest as "starvation porridge." They now come to the allowances, as above, handed them by law. The meal, the tea, the rice, the sugar, and molasses prove frequently a puzzler—tea in particular—and it is not unfrequently the case that a brawny Pat, who could do a good turn at Donnybrook fair, but whose knowledge of drinkables is confined to whisky, will, after gravely surveying the tea for a while, deliberately fill his pipe with a portion, and smoke it with much satisfaction. Others, with more expansive ideas, will at times mix the whole in a mass, and boil it into a thick soup or pudding, well specked with the expanded tea leaves. Information comes with experience, however, and the first serious experience is sea-sickness, which utterly prostrates them, mind and body, aggravating every dirty habit they may have formed. Then is exerted the utmost power of the captain to enforce cleanliness; he usually selects a dozen or two of the more intelligent, and investing them with authority, a general turn-out, and a thorough cleaning every morning, and in all weathers, is compelled.

By the rigid observance of this rule, much of the former sickness and mortality has been avoided. Within the past decade the emigration from Ireland had materially declined, even the famine year not greatly increasing it; and the working classes, and especially the tenant farmers in England who had had five or six years of bad crops had taken their place on the emigrant ships. The English emigrant is generally more quiet and industrious than the Irishman, and is not so open and shameless a beggar; but unless he is a mechanic, he is not so enterprising and pushing, and requires some one to plan for him, and get him into a situation. A larger proportion of the English as well as the German and Scandinavian emigrants go west immediately on landing at American ports, than of the Irish. The Irishman seems to regard the large cities as peculiarly his home. Here in the past, he has found his advantage in being able to vote (often illegally) for the demagogues who sought his vote to accomplish their nefarious purposes; and at one time so large a proportion of the public offices in our large cities were held by Irishmen, often wholly unfit for the positions, that it is no wonder that one of these unwashed politicians sent word to one of his friends in Ireland: "I tell yees, Pat, it's worth a big fortin' to a man here, to have been born in ould Ireland."

There is, however, less of Irish predominance in our large cities than there was a few years ago, but there is still too much. Within the past two years great efforts have been made to collect subscriptions here from Irishmen and others in aid of the Land League in Ireland, whose object is to resist and defy by all means, however unscrupulous, the authority of the English government. Murder, house and barn-burning, the destruction of warehouses and ships by dynamite, beating and assaulting those who have paid their rents, and other measures such as Irish ingenuity could invent, have been threatened and practiced often upon innocent and helpless victims of the Land-leaguer's rage. Emigration from Ireland has been checked for the present by these measures, but will probably be resumed when the country is more quiet.

## CHAPTER III.

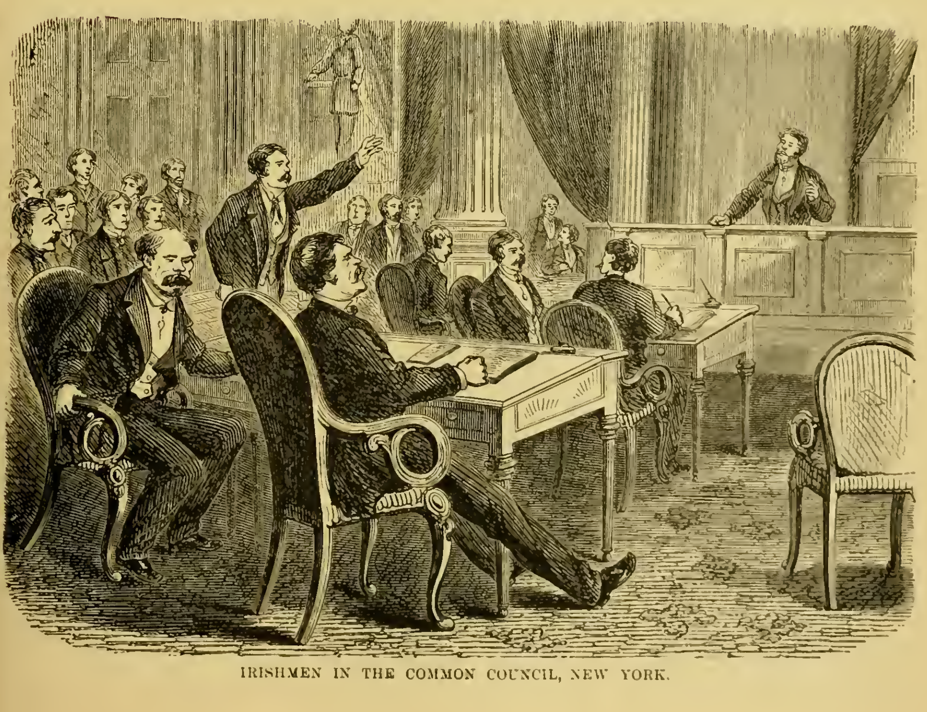
### EMIGRANTS LANDING AT NEW YORK.

The commissioners of emigration, a body appointed by the Legislature of New York in 1847, to receive and care for the emigrants landing at the port of New York, and to see to it that neither they nor the state should receive damage, have made Castle Garden at the Battery, New York city, the landing depôt, and have also established a State Emigrant Refuge and hospitals at which emigrants may be received without charge in case of illness or destitution, within five years after landing.

At Castle Garden the emigrants are allowed to stay for a few days, and they can procure there the tickets for transportation on the western railways at the lowest prices, and can be conducted to the trains without annoyance. Their foreign coins can be exchanged and every precaution is taken to protect them from being robbed, swindled, or in any way defrauded, by any of the thousand villains who lie in wait for them outside.

There is also a Labor and Employment Bureau for finding employment for those who wish to obtain places in the vicinity, and most of the states which are inviting immigration have their agents there to give information in regard to the inducements they have to offer to immigrants. Very many of the land-grant railroad companies, and the land companies, now have their agents at the foreign ports, and a large proportion of the immigrants are ticketed through from Liverpool, Glasgow, Edinburgh, Hull, Bristol, Bremen, Hamburg and other European ports by steamer and railway to the lands owned by these companies, and, in some instances, have bought their farms without ever having seen them. The commissioners were allowed to require a bond from the owners of emigrant ships for each emigrant, that he or she should not become chargeable to the state for the term of five years after landing, and in lieu of this they were authorized to receive a sum in commutation of from $1.50 to $2.50 for each emigrant. They put this commutation at first at $2.00, and in May, 1871, reduced it to $1.50. In 1876 the Supreme Court of the United States decided that the law authorizing the collection of this commutation was void, as the matter belonged to Congress and not to the state authorities. As this decision made them liable for past commutations, Congress passed a law promptly which legalized their past action, but prohibited any further collections. While the matter of granting national authority for collecting the commutation was pending in Congress, where it has not yet reached a vote, the state of New York made annual appropriations to the commissioners of from $150,000 to $175,000, that their good work might not be relinquished. The commutation or head money would seem


IRISH EMIGRANTS JUST ARRIVED IN NEW YORK.



IRISHMEN IN THE COMMON COUNCIL, NEW YORK.

to be the fairest and best method of maintaining the necessary work of the commissioners.

The emigration into the port of New York is at all times much larger than to any other port, and averages at least five-eighths of the immigration into all the ports. In 1881 there were 409,106 alien passengers landed at New York out of a total of 695,163; and 400,871 immigrants out of a total of 669,431. This was for the fiscal year ending June 30, 1881. For the calendar year 1881, the number was still greater; and the immigration of 1882 has taken on such proportions that a total of over a million is confidently predicted, of which New York will probably receive at least 700,000.

A large majority of those who land at New York have their friends awaiting them to guide them to their future homes. Numbers have to seek their way amid great perils. But nearly all these have come provided with instructions more or less minute, derived from the numerous agents in Europe of the American land companies, who hold out inducements to settlers. The Germans and Swedes are mostly inclined to agriculture, or to the raising of cattle, and mining, and they soon find their way, by the emigrant trains of the great trunk lines of railroads. Those lines have all exerted themselves to profit by the movement.

The following table, from official sources, gives the number of Germans and British under each head, and also the aggregate of all the aliens arrived since the returns have been regularly kept. Some of the passengers report themselves from Great Britain, without stating which portion. These are under the head "Great Britain." [See page 242.]

Let us see next where this vast emigration of nearly eleven and a half millions in sixty-one years have made their homes on this side of the ocean. While their aggregate number has increased in each of the last three decades, being 4,136,175 in 1860, 5,566,546 in 1870, and 6,679,943 in 1880, showing that a little more than three-fifths of the whole number who had immigrated hither were living in 1880, the proportion to the native population has been lessening and in thirty-five of the forty-eight states and territories the native population has increased in a larger ratio than the foreign. While the foreign element is only one-eighth of the whole, in our population, there is not much danger of our being swamped by immigration. The census of 1880 has not yet given the full details in all the states of the nationalities of the immigrants making their homes there; and we do not regard it as a matter of much consequence, as changes are so constantly taking place in the location of immigrants, many of whom now come in large bodies, and if dissatisfied with their first location migrate to another state or territory by hundreds or thousands. In general we may say that the English, Irish and Scotch are more inclined to settle in the Atlantic and Mississippi Valley states than farther west. Many of them are mechanics, artisans or unskilled laborers; many more, farm hands, or household servants, and these find employment more readily in the densely populated east than in the west, of late, however, a class of greater wealth are coming here,—tenant farmers, men connected with the army, navy, the professions, or the civil service, and not seldom younger sons of the gentry or nobility. These often go to the west. The Germans divide themselves pretty equally over the whole northern portion of the country; miners, herdsmen and agriculturists going to the west and northwest, tradesmen and mechanics remaining at the east. The Scandinavians, who are agriculturists, miners, herdsmen, or professional men, go to the northwest, to Wisconsin, Minnesota, Iowa, Dakota, Montana, Nebraska and Kansas, and some of them to Wyoming, Oregon and Washington. The Mormons draw considerable numbers of both these and the English and Welch to Utah, and the territories adjacent. The Russian emigration, which is becoming large and is mostly Mennonite, go directly to Minnesota, Dakota, Manitoba, Nebraska or Kansas. The Italians, who are now coming in considerable numbers, are mostly finding employment in the Atlantic cities and towns; a few, however, go to California, attracted by the fine climate. Mexicans, Spaniards and Frenchmen go for the most part to Arizona, California and Texas; the Chinese to the Pacific states. In Utah in 1880, 40,321 out of 43,994 were from Great Britain and Ireland, Sweden and Norway. The Canadians of British extraction go mostly to the northwest; the

NUMBER OF PASSENGERS THAT ARRIVED IN EACH YEAR IN THE UNITED STATES FROM ENGLAND, IRELAND, SCOTLAND, GREAT BRITAIN, GERMANY, SWEDEN AND NORWAY, WITH THE TOTAL FROM ALL COUNTRIES.

| | England. | Ireland. | Scotland. | Gt. Britain. | Germany. | Switzer-land. | Prussia.* | Sweden & Norway. | Total. |
|---|---|---|---|---|---|---|---|---|---|
| 1820, | 1,782 | 1,725 | 268 | 2,249 | 948 | 31 | 20 | ........ | 8,385 |
| 1821, | 1,036 | 1,518 | 293 | 1,881 | 365 | 93 | 18 | ........ | 9,127 |
| 1822, | 856 | 1,346 | 198 | 1,088 | 139 | 110 | 9 | ........ | 6,911 |
| 1823, | 851 | 1,051 | 180 | 926 | 179 | 47 | 4 | ........ | 6,354 |
| 1824, | 713 | 1,575 | 257 | 1,064 | 224 | 253 | 6 | ....... | 7,912 |
| 1825, | 1,002 | 4,157 | 113 | 1,711 | 448 | 166 | 2 | ........ | 10,199 |
| 1826, | 1,459 | 3,333 | 230 | 2,705 | 495 | 245 | 16 | ........ | 10,837 |
| 1827, | 2,521 | 3,282 | 460 | 7,689 | 435 | 297 | 7 | ........ | 18,875 |
| 1828, | 2,735 | 5,266 | 1,041 | 8,798 | 1,806 | 1,592 | 45 | ........ | 27,382 |
| 1829, | 2,149 | 3,106 | 111 | 5,228 | 582 | 314 | 15 | ........ | 22,520 |
| 1830, | 733 | 747 | 29 | 2,365 | 1,972 | 109 | 4 | ........ | 23,322 |
| 1831, | 251 | 1,647 | 226 | 6,123 | 2,395 | 63 | 18 | ........ | 22,633 |
| 1832, | 944 | 5,120 | 158 | 11,545 | 10,168 | 129 | 26 | ........ | 53,179 |
| 1833, | 2,966 | 4,511 | 1,921 | 4,166 | 6,823 | 634 | 155 | ........ | 58,640 |
| 1834, | 1,129 | 6,772 | 110 | 26,953 | 17,654 | 1,389 | 32 | ........ | 65,365 |
| 1835, | 468 | 5,148 | 63 | 24,218 | 8,245 | 548 | 66 | ........ | 45,374 |
| 1836, | 420 | 2,152 | 106 | 41,006 | 20,139 | 445 | 568 | ........ | 76,242 |
| 1837, | 896 | 737 | 14 | 39,079 | 23,036 | 383 | 704 | .... ... | 79,340 |
| 1838, | 157 | 1,225 | 48 | 16.635 | 11,369 | 123 | 314 | ....... | 38,714 |
| 1839, | 62 | 1,199 | ........ | 32,973 | 19,794 | 607 | 1,234 | ........ | 68,069 |
| 1840, | 318 | 677 | 21 | 41,027 | 88,581 | 500 | 1,123 | ....... | 84,066 |
| 1841, | 147 | 3,291 | 35 | 50,487 | 13,727 | 751 | 1,564 | ........ | 80,289 |
| 1842, | 1,743 | 4,844 | 24 | 66,736 | 18,287 | 483 | 2,083 | ........ | 104,565 |
| 1843, | 3,517 | 1,173 | 41 | 23,369 | 11,432 | 553 | 3,009 | ........ | 52,496 |
| 1844, | 1,357 | 5,491 | 23 | 40,972 | 19,226 | 839 | 1,505 | ........ | 78,615 |
| 1845, | 1,710 | 8,641 | 368 | 53,312 | 33,138 | 471 | 1,217 | ........ | 114,371 |
| 1846, | 2,854 | 12,949 | 305 | 57,824 | 57,010 | 698 | 551 | ........ | 154,416 |
| 1847, | 3,476 | 29,640 | 337 | 95,385 | 73,444 | 192 | 837 | ........ | 234,968 |
| 1848, | 4,445 | 24,802 | 659 | 118,277 | 58,014 | 319 | 451 | ........ | 226,527 |
| 1849, | 6,035 | 31,321 | 1,060 | 175,841 | 60,062 | 13 | 173 | ........ | 297,024 |
| 1850, | 6,797 | 40,180 | 860 | 167,242 | 78,137 | 375 | 759 | ........ | 369,980 |
| 1851, | 5,306 | 55,874 | 966 | 210,594 | 71,322 | 427 | 1,160 | ........ | 379,466 |
| 1852, | 30,007 | 159,548 | 8,148 | 2,544 | 143,575 | 2,788 | 2,343 | ....... | 371,603 |
| 1853, | 28,857 | 162,649 | 6,006 | 2,703 | 140,653 | 2,748 | 1,293 | ........ | 368,645 |
| 1854, | 48,901 | 101,606 | 4,605 | 5,141 | 206,054 | 2,953 | 8,955 | ........ | 427,883 |
| 1855, | 38,871 | 49,627 | 5,275 | 1,176 | 66,219 | 4,433 | 5,699 | ........ | 200,877 |
| 1856, | 25,904 | 54,349 | 3,297 | 15,457 | 63,807 | 1,780 | 7,221 | ........ | 200,436 |
| 1857, | 27,804 | 54,361 | 4,182 | 26,493 | 83,798 | 2,080 | 7,983 | ........ | 251,306 |
| 1858, | 14,638 | 26,873 | 1,946 | 12,372 | 42,291 | 1,056 | 3,019 | ........ | 123,126 |
| 1859, | 13,826 | 35,216 | 2,293 | 10,045 | 39,315 | 833 | 2,469 | ........ | 121,282 |
| 1860, | 13,001 | 48,637 | 1,613 | 15,123 | 50,746 | 913 | 3,745 | ........ | 153,640 |
| 1861, | 8,970 | 23,797 | 767 | 9,938 | 30,189 | 1,007 | 1,472 | 616 | 91,920 |
| 1862, | 10,947 | 23,351 | 657 | 13,035 | 24,985 | 643 | 2,544 | 892 | 91,987 |
| 1863, | 24,065 | 55,916 | 1,940 | 40,878 | 31,989 | 690 | 1,173 | 1,627 | 176,282 |
| 1864, | 25,096 | 63,523 | 3,476 | 23,856 | 54,379 | 1,896 | 2,897 | 2,249 | 193,416 |
| 1865, | 15,038 | 29,772 | 3,037 | 64,390 | 80,797 | 2,859 | 2,627 | 6,109 | 249,061 |
| 1866, | 2,770 | 32,312 | 672 | 95,866 | 110,440 | 3,823 | 5,452 | 12,633 | 318,494 |
| 1867, | ........ | 69,977 | ........ | 55,543 | 121,240 | 1,168 | 12,186 | 7,055 | 298,358 |
| 1868, | 11,107 | 42,747 | 1,949 | 51,779 | 111,503 | 3,261 | 11,567 | 20,420 | 297,215 |
| 1869, | 55,046 | 51,290 | 12,415 | 28,965 | 124,766 | 3,488 | 22 | 41,833 | 395,922 |
| 1870, | 59,488 | 56,628 | 11,820 | 23,153 | 91,168 | 2,474 | 111 | 24,365 | 376,314 |
| 1871, | 57,429 | 57,439 | 11,984 | 142,894 | 82,554 | 2,269 | ... ..... | 20,117 | 321,350 |
| 1872, | 70,978 | 68,732 | 13,916 | 153,641 | 141,109 | 3,650 | ......... | 24,885 | 404,806 |
| 1873, | 75,641 | 77,344 | 13,841 | 166,843 | 149,671 | 3,107 | ... ..... | 30,550 | 459,803 |
| 1874, | 51,570 | 53,707 | 10,429 | 115,728 | 87,291 | 3,093 | ......... | 16,096 | 313,339 |
| 1875, | 40,579 | 37,957 | 7,310 | 85,861 | 47,769 | 1,814 | ......... | 11,666 | 227,498 |
| 1876, | 24,697 | 19,575 | 4,582 | 48,866 | 31,937 | 1,549 | ..... ... | 10,776 | 169,986 |
| 1877, | 19,442 | 14,569 | 4,135 | 38,150 | 29,298 | 1,686 | ......... | 9,579 | 141,857 |
| 1878, | 18,648 | 15,932 | 3,502 | 38,082 | 29,313 | 1,808 | ......... | 10,149 | 138,469 |
| 1879, | 24,726 | 20,013 | 5,225 | 49,967 | 34,602 | 3,161 | ......... | 18,346 | 177,826 |
| 1880, | 60,627 | 71,603 | 12,640 | 144,876 | 84,638 | 6,156 | ......... | 59,081 | 457,257 |
| 1881, | 76,547 | 70,909 | 16,451 | 165,230 | 249,572 | 11,628 | ......... | 82,859 | 720,045 |
| Total, | 1,313,630 | 2,795,978 | 232,915 | 4,379,718 | 4,691,247 | 132,530 | *155,791 | 365,173 | 11,436,235 |

*Merged in Germany after 1870.

THE FOREIGN POPULATION IN EACH STATE AND TERRITORY IN 1850, 1860, 1870, AND 1880, WITH THE RATIO TO 100,000 NATIVES IN EACH IN 1870 AND 1880.

| State. | Foreign. 1850. | Foreign. 1860. | Foreign. 1870. | Foreign. 1880. | Number of Foreign to 100,000 Native. | |
|---|---|---|---|---|---|---|
| | | | | | 1870. | 1880. |
| United States.... | 2,244,602 | 4,138,697 | 5,567,229 | 6,679,943 | 16,875 | 15,364 |
| Alabama.......... | 7,509 | 12,352 | 9,962 | 9,734 | 1,009 | 776 |
| Arizona.......... | .......... | .......... | 5,809 | 16,049 | 150,922 | 65,798 |
| Arkansas.......... | 1,471 | 3,600 | 5,026 | 10,350 | 1,048 | 1,306 |
| California.......... | 21,802 | 146,528 | 209,831 | 292,874 | 59,881 | 51,217 |
| Colorado.......... | .......... | 2,666 | 6,599 | 39,790 | 19,838 | 25,747 |
| Connecticut........ | 38,518 | 80,696 | 113,639 | 129,992 | 26,813 | 26,383 |
| Dakota.......... | .......... | 1,774 | 4,815 | 51,795 | 51,409 | 62,117 |
| Delaware.......... | 5,253 | 9,165 | 9,136 | 9,468 | 7,884 | 6,903 |
| Distr't of Columbia. | 4,918 | 12,484 | 16,254 | 17,122 | 14,079 | 10,667 |
| Florida.......... | 2,769 | 3,309 | 4,967 | 9,909 | 2,717 | 3,817 |
| Georgia.......... | 6,488 | 11,671 | 11,127 | 10,564 | 949 | 689 |
| Idaho.......... | .......... | .......... | 7,885 | 9,974 | 110,838 | 44,062 |
| Illinois.......... | 111,892 | 324,643 | 515,198 | 583,576 | 25,446 | 23,396 |
| Indiana.......... | 55,572 | 118,284 | 141,474 | 144,178 | 9,192 | 7,860 |
| Iowa.......... | 20,969 | 106,077 | 204,692 | 261,650 | 20,690 | 19,197 |
| Kansas.......... | .......... | 12,691 | 48,392 | 110,086 | 15,314 | 12,424 |
| Kentucky.......... | 31,420 | 59,799 | 63,398 | 59,517 | 5,041 | 3,745 |
| Louisiana.......... | 68,233 | 80,975 | 61,827 | 54,146 | 9,296 | 6,112 |
| Maine.......... | 31,825 | 37,453 | 48,881 | 58,883 | 8,456 | 9,979 |
| Maryland.......... | 51,209 | 77,529 | 83,412 | 82,806 | 11,959 | 9,717 |
| Massachusetts...... | 164,024 | 260,106 | 353,319 | 443,491 | 32,003 | 33,106 |
| Michigan.......... | 54,703 | 149,093 | 268,019 | 388,508 | 29,257 | 31,119 |
| Minnesota.......... | 1,977 | 58,728 | 160,697 | 267,676 | 57,596 | 52,168 |
| Mississippi.......... | 4,788 | 8,558 | 11,191 | 9,209 | 1,370 | 820 |
| Missouri.......... | 76,592 | 160,541 | 222,267 | 211,578 | 14,827 | 10,812 |
| Montana.......... | .......... | .......... | 7,979 | 11,521 | 63,245 | 41,685 |
| Nebraska.......... | .......... | 6,351 | 30,748 | 97,414 | 33,333 | 27,441 |
| Nevada.......... | .......... | 2,064 | 18,801 | 25,653 | 79,363 | 70,065 |
| New Hampshire.... | 14,265 | 20,938 | 29,611 | 46,294 | 10,257 | 15,395 |
| New Jersey........ | 59,948 | 122,790 | 188,943 | 221,700 | 26,346 | 24,378 |
| New Mexico....... | 2,151 | 6,723 | 5,620 | 8,051 | 6,516 | 7,219 |
| New York......... | 655,929 | 1,001,280 | 1,138,353 | 1,211,379 | 35,087 | 31,289 |
| North Carolina..... | 2,581 | 3,298 | 3,029 | 3,742 | 284 | 268 |
| Ohio.......... | 218,193 | 328,249 | 372,493 | 394,943 | 16,246 | 14,089 |
| Oregon.......... | 1,022 | 5,123 | 11,600 | 30,503 | 14,624 | 21,143 |
| Pennsylvania...... | 303,417 | 430,505 | 545,309 | 587,829 | 18,310 | 15,908 |
| Rhode Island...... | 23,902 | 37,394 | 55,396 | 73,993 | 34,204 | 36,532 |
| South Carolina..... | 8,707 | 9,986 | 8,074 | 7,686 | 1,158 | 778 |
| Tennessee.......... | 5,653 | 21,226 | 19,316 | 16,702 | 1,559 | 1,054 |
| Texas.......... | 17,681 | 43,422 | 62,411 | 114,616 | 8,254 | 7,759 |
| Utah.......... | 2,044 | 6,723 | 30,702 | 43,994 | 54,743 | 44,007 |
| Vermont.......... | 33,715 | 32,743 | 47,155 | 40,959 | 16,639 | 14,059 |
| Virginia.......... | 22,985 | 18,513 | 13,754 | 14,696 | 1,135 | 981 |
| Washington.......... | .......... | 3,144 | 5,024 | 15,803 | 26,541 | 26,643 |
| West Virginia...... | .......... | 16,545 | 17,091 | 18,265 | 4,022 | 3,043 |
| Wisconsin.......... | 110,477 | 276,927 | 364,499 | 405,425 | 52,813 | 44,548 |
| Wyoming.......... | .......... | .......... | 3,513 | 5,850 | 62,676 | 39,159 |

French Canadians to New England and New York, largely as factory operatives. Very few emigrants go to the southern states, except to Texas, Louisiana and Florida. The following table gives the number of persons of foreign birth in each state and territory in 1850, 1860, 1870 and 1880, and the proportion to each hundred thousand of natives in 1870 and 1880. [See page 243.]

Many attempts have been made to estimate the amount of capital brought into the country by immigrants, but these, for obvious reasons, must be mere guess-work. The commissioners of emigration in New York in 1871 made an investigation which led them to the conclusion that besides their passage money the immigrants averaged $100 each, and calculated that from September 30. 1819, to December 31, 1870, the 7,360,475 alien passengers had brought $736,047,500. At that rate the whole sum brought to December 31, 1881, would be $1,168,623,500. But this estimate is and has been all along largely below the truth. Very few emigrant families bring less than $1,000 for each family—and many still larger sums. The Mennonites, who are coming here in such large numbers, bring very large amounts. One Mennonite colony of 200 persons had with them $400,000, after reaching their destination. Another, somewhat larger colony, purchased 200,000 acres of land in Kansas, and still had money enough to lay it out in farms, erect the necessary buildings and stock it. The best land companies advise no man with a family to immigrate unless he has at command at least $1,000. Many of the English and Scotch farmers bring very considerable sums, and generally invest them wisely. This is also true of the Scandinavians. Many of the mining and smelting enterprises, irrigating works and land, agricultural, and herding companies, are conducted by English, French or German capitalists, and with capital drawn from those countries, sometimes to the amount of millions of dollars. This is particularly true in Colorado, Nevada, Utah, Idaho, Montana, Dakota and California.

But the large amounts brought over by immigrants are very nearly balanced by the vast aggregate of small sums sent over by immigrants to their friends to aid them in supporting themselves there, or to pay their passage to this country. The Irish, English, Swedes, Norwegians and Swiss, as well as some of the German immigrants, especially those of these nationalities in service here, make remittances every two or three months—and the aggregate is very large.

Returning emigrants also carry back large sums to their homes. Many of the Chinese manage in a few years to return to China, with a sum sufficient for a permanent competence there.

But the largest amount of money returned to Europe is that expended by Americans who go thither for pleasure or business each season. From the various ports of the United States in 1881, 112,072 persons sailed, mostly for Europe—100,446 of them in steamers, and 63,593 as cabin passengers. In the thirteen years ending in 1881 the whole number of these departing passengers was 1,487,989. That the average expenditure of these passengers abroad was not less than $1,000 each, is susceptible of easy proof, and the grand aggregate for thirteen years is $1,487,989,000 ; a larger sum than, according to the estimates of the commissioners of emigration, all the emigrants for sixty-one years have brought here. Many well informed publicists put the amount expended by each passenger or traveler at $1,200, and adduce evidence showing that it must even exceed that sum. The arrivals of native citizens and foreign visitors (not immigrants) from abroad have been recorded since 1820 with the exception of the period from 1861 to 1868 (both inclusive) and is as follows :

NUMBER OF NATIVE CITIZENS AND FOREIGN VISITORS (NOT IMMIGRANTS) ARRIVING FROM ABROAD.

| | Males. | Females. | Not stated. | Total. |
|---|---|---|---|---|
| 1820–1830, | 19,542 | 3,529 | 62 | 23,134 |
| 1830–1840, | 23,036 | 7,288 | 31 | 34,345 |
| 1840–1850, | 38,952 | 12,999 | 190 | 52,141 |
| 1850–1860, | 224,410 | 36,924 | ... | 261,348 |
| 1869–1871, | 99,373 | 52,030 | ... | 151,403 |
| 1871–1881, | ....... | ...... | ... | 744,105 |

Total arrivals of non-emigrants in 61 years, 1,266,476

But while the money income from immigrants is probably nearly or quite cancelled by the amount sent abroad either by the immigrants themselves, or by American citizens traveling for business or pleasure, the value of the labor and enterprise of the larger proportion of this vast influx of able bodied men and women is much greater than the money they have brought with them. But for their toil and industry extensive regions now teeming with population and wealth would still be barren wastes, and the progress of the country would have been delayed probably almost a third of a century.

That we have, as a nation, treated immigrants fairly and generously (except, perhaps, the Chinese) is evident from the fact that ours is the only country in which immigration has been in the highest sense a success. The Australian colonies, though moderately prosperous, and though the British government has used every effort to protect and increase emigration thither, have received in all less than one-fifth the immigrants which have come to us. Canada has received many immigrants, but a very large proportion of them have made haste to escape over our borders; while Mexico and the South American States, and all of Africa, have met with no tangible success in their efforts to encourage immigration.

With us the legal rights of the emigrants, after they become naturalized, are the same in all respects as those of the native-born citizens, with the single exception that they are not eligible to the office of president or vice-president of the United States. No law can be passed to abridge the freedom of their speech, or the free exercise of their religion, whatever that may be. Their right to hold real estate is perfect, as is the security afforded to persons, property, and papers, and they may be elected, or may elect to any office except those named.

# TELEGRAPHS—THEIR ORIGIN AND PROGRESS.

## CHAPTER I.

### TELEGRAPHS—THEIR ORIGIN AND PROGRESS.

"Canst thou send lightnings that they may go, and say unto thee, 'Here we are'?"—*Job.*

THE invention and use of electric telegraphs are among the most important of modern improvements; and it is somewhat remarkable that the invention justifies the trite observation, that great inventions are made always at the moment they are wanted. Telegraphs have been used from the remotest antiquity, by signals of various kinds; and one by flags, to signal the arrival of vessels below, has been used during the present century in Boston; and, in New York, one operating by arms has been used for the same purpose from the Narrows to the roof of the Merchants' Exchange in New York. The electric telegraph applied lightning to intelligence as steam was applied to motion, and came into being to exceed, by its rapidity of intelligence, the means just invented to convey more rapidly by rail. Indeed its action is necessary to the latter, since it would be impossible to operate long lines of railroad, like the Erie, N. Y. Central, Penn., and Balt. & Ohio, without the aid of the telegraph. The patent of Morse was taken out in the year 1840, and for all short lines, is still employed; but the necessity for more rapid communication, and for the reduction of expenses in a business so enormous, has led to other inventions which have quadrupled the power of a single line, and by automatic process, have actually increased it a hundredfold with but very little addition to the expense. The present improved processes bear about the same relation to the original Morse's telegraph that the lightning express train does to the old Conestoga wagon. But more of this by and by. At present our business is with Morse's original discovery.

It was just ninety years after Dr. Franklin identified lightning with electricity, by means of his kite, when Morse schooled electricity to send messages almost instantaneously over wire at great distances.

This all-pervading element manifests itself in countless ways—in the sparkling of animal hair; in the rustling of silk, which "betrays your poor heart to woman;" in the aurora that illumines the North; in the meteor that startles the astonished observer; it flashes in the lightning bolt that rives the oak, without, while it gently penetrates into the lady's parlor and fills her form, as she glides over her warm, thick carpet, until the metal tube of the gas burner will attract enough from her fingers to ignite the gas, or from her lips to startle a newly-entered friend. It will also convey to her the thoughts of distant minds with more than the assiduity of Puck, by means of the invention of Morse.

Professor Morse was not the discoverer of the analogy between magnetism and electricity, but he was the first who made practicable former discoveries and improvements in the production of a recording telegraph. The three leading properties of electricity that make telegraphs possible, are, first, its constant desire to seek an equilibrium, always going where there is less; second, that the production of electricity is always in two fluids, called positive and negative, which possess a mutual attraction for each other; third, that different substances have very different conducting powers—over some it passes with the utmost freedom, while over others it will scarcely pass at all. On this depends the possibility of telegraphing, since by it the current of electricity may be arrested or conveyed at the will of the operator. Mr. William Sturgeon of London, discovered in 1825 that when a bar of soft iron was placed within a coil of conducting wires it was rendered magnetic, and and would so remain as long as the current of electricity passed through the wires. The telegraph consists in connecting two of these magnets by a wire of any number of miles in length, and directing through it a current from an electric battery. By cutting off the current, the iron becomes alternately charged and at rest with great rapidity. To form the current, it is necessary that the wire should form a circuit, or that each end of the wire should communicate with the ground. The interruption is caused by stopping this communication. The first telegraph invented by Professor Morse consisted of an electro-magnet, formed by bending a small rod of iron in the form of a horse-shoe, upon which was wound a few yards of copper wire insulated with cotton thread. This magnet was then placed upon the middle of a painter's stretching frame for canvass, the bottom of which was nailed to the edge of a common table. Across the lower part of the frame was constructed a narrow trough to hold three narrow cylinders of wood. A wooden clock was placed at one end of this trough. The cylinder next to the clock had a small pulley-wheel fixed upon its prolonged axis, outside the trough; a similar pulley-wheel was fixed upon the prolonged axis of one of the slower wheels of the train of wheels outside the clock; these two pulley-wheels were connected by an endless cord or band. Upon the cylinder farthest from the clock was wound a ribbon of paper, which, when the clock train was put in motion was gradually unrolled and passing over the middle cylinder was rolled up upon the cylinder nearest the clock by means of the cord and pulleys.

An A shaped pendulum was suspended by its apex from the centre of the top of the frame, directly above the centre of the middle cylinder in the trough below. This lever was made of two thin rules of wood meeting at the top but opening downwards about one inch apart and joined at the bottom by a transverse bar (which was close to the paper as it moved over the middle cylinder,) and another about one inch above it. Through the centre of these two bars a small tube was fixed through which a pencil loosely played. The pencil had a small weight upon its top to keep the point in constant contact with the paper ribbon. Upon the lever directly opposite to the poles of the electro-magnet was fastened the armature of the magnet or a small bar of soft iron. The movement of the lever was guided by stops on the frame at the sides of the lever, permitting it only a movement forward to and back from the magnet; the pencil at the bottom of the lever was thus allowed to advance when the magnet was charged and to retreat when discharged, about one eighth of an inch. The lever advanced by the attraction of the magnet and was retracted by a weight or spring.

The voltaic battery or generator of electricity was connected by one of its poles to one of the helices of the magnet while the other pole was connected with a mercury cup; and a conjunctive wire connected a second mercury cup to the other helix of the magnet. The circuit was closed by dipping a forked wire into the two cups of mercury, when the magnet became charged, the armature was attracted, and the lever drawn toward the magnet. When the forked wire was removed the magnet was discharged and the spring brought back the lever to its normal position. When the clock work was put in motion the ribbon of paper was drawn over the middle cylinder and the pencil attached to the lever being in constant contact with the ribbon of paper traced a continuous line lengthwise with the ribbon.

The pathway of the pencil point, when the lever was attracted towards and held by the magnet for a longer or shorter time, contains the three elements of points, spaces and lines, forming by their various combinations, the various conventional characters for numerals and letters.

Professor Morse subsequently modified the form of his telegraph, although the principle upon which its action depended remained substantially the same. In place of the wooden cylinders operated by a wooden clock for carrying the paper band at a regular rate, he employed small brass rollers moved by means of mechanism analagous to clock-work; and instead of the armature being attached to a wooden pendulum which vibrated over the paper, he attached it to one end of a brass lever sustained in a horizontal position by two pivots, the other end of the lever being armed with a steel point. Under the soft iron armature at one end of the lever was placed an electro-magnet, while the steel point at the other end of the lever, was beneath the roller which carried the band of paper. Now when the circuit is closed—that is completed—the armature of the electro-magnet is attracted through the magnetism created in the helix by the passage of the electric current, and this attraction causes the point of the pen to touch the paper and to trace upon it a line the length of which depends upon the duration of time in which the circuit remains whole. If the circuit is opened the current ceases to flow, the magnetism disappears instantly and a spring attached to the lever draws it away from the paper and the line ceases. By opening and closing the circuit rapidly dots are produced upon the paper the number of which depends upon the number of times that the circuit is broken and closed. If the circuit is closed for a longer time a dash or a short line is made upon the paper. We have thus the combinations of an alphabet of dots and lines. Thus *a* is a dot and a dash, *b* a dash and three dots, &c. The alphabet is so arranged that those letters occurring most frequently are more easily transmitted; thus *e* is one dot; *t* one dash. An expert operator can transmit from thirty to forty words a minute by this instrument on a land line of 200 or 300 miles in length.

The transmitting apparatus is very simple, being designed only for the opening and closing of the circuit in a manner more easy than by holding the ends of the wire in the hands, as is done where there is no apparatus. The two ends of wire are separated by two pieces of metal, one of which is a brass lever surmounted by an ivory button, and the other is a brass anvil tipped with platinum. The brass lever is mounted upon pivots, in front of the axis of which is soldered a nipple of platinum, which by the depression of the lever comes in contact with the platinum tipped anvil, and thus closes the circuit.

To the Morse system at a later period, was added the "sounder," a simple contrivance, by which signals are conveyed by sound. Up to 1850 the operator read the dispatch from slips of paper to the copyist, who wrote it down. It was soon found, however, that the despatch could be read by the "click" of the instruments, and the operator now copies, himself, from sound.

The number of inventions connected with the electric telegraph is almost endless, and would engross a long series of volumes for their description.

Professor Morse had no sooner shown that a telegraph could be constructed through the aid of electricity than his attention was turned to the discovery of some insulating substance by means of which the wires could be enveloped and buried in the earth, it not being deemed practicable to place them in the open air. Tarred yarn saturated with a preparation of asphaltum, was among the first insulating materials used for this purpose, and the lines constructed in 1843 were covered with this substance, and buried in the earth. This insulation proved so faulty, however, that it was at once abandoned, and the wires were insulated with glass upon poles in the open air. Still if it was decided to relinquish the idea of building subterranean lines, the fact was apparent that some good insulating material must be found which would permit the submergence of the wires across straits or navigable rivers. Various substances were tried to accomplish this result, but nothing satisfactory was obtained until the discovery of gutta percha, which proved to be one of the most perfect insulators known, and admirably adapted by its plastic and flexible qualities for the insulation of submarine wires.

In 1850 the first electric cable was laid in the open sea between England and France. This cable consisted of a solid copper wire, covered with gutta percha. The landing place in France was Cape Grissiez, from which place a few messages passed sufficient to test the accuracy of the principle. The communication thus established between the continent and England was, after a few hours, abruptly stopped. A diligent fisherman, plying his vocation, took up part of the cable in his trawl and cut off a piece which he brought in triumph to Boulogne, where he exhibited it as a specimen of rare sea-weed, with its center filled with gold. It is believed that this *piscator ignobilis* returned again and again to search for further specimens of this treasure of the deep. It is, at all events, perfectly certain that he succeeded in destroying the submarine cable.

The first of the Atlantic cables was repeatedly broken, near its shore ends, by the anchors of large steamships, and after a doubtful existence of some months, at last "died and made no sign." After the successful laying of the cables of 1866 and 1867 it was revived, and in now in service.

This accident caused the attention of scientific men to be directed to the discovery of some mode of preservino submarine cables from similar casualties, and it was decided, that the wire insulated by gutta percha should form a core or centre to a wire rope, so as to give protection to it during the process of paying out and laying down, as well as to guard it from rocks and the anchors of vessels.

In 1851 a cable protected in this manner was laid between Dover and Calais, where it has ever since remained in perfect order, constituting the great channel of electrical communication between England and the continent. The success of that form of cable having been thus completely established, lines of a similar character were subsequently laid in all quarters of the world.

Amongst the most important submarine lines are those which were laid across the Atlantic Ocean in 1865 and 1866.

The conductor of these cables consists of a copper strand of seven wires, six laid round one, and weighing 300 lbs. per mile.

The insulation consists of four layers of gutta percha laid in alternately with four thin layers of Chatterton's compound.

The external protection consists of ten steel wires, each wire surrounded separately with five strands of tarred Manilla hemp and the whole laid spirally round the core, which latter is padded with tanned jute yarn. Each cable would bear eleven knots of itself in water without breaking.

Fig: 1.

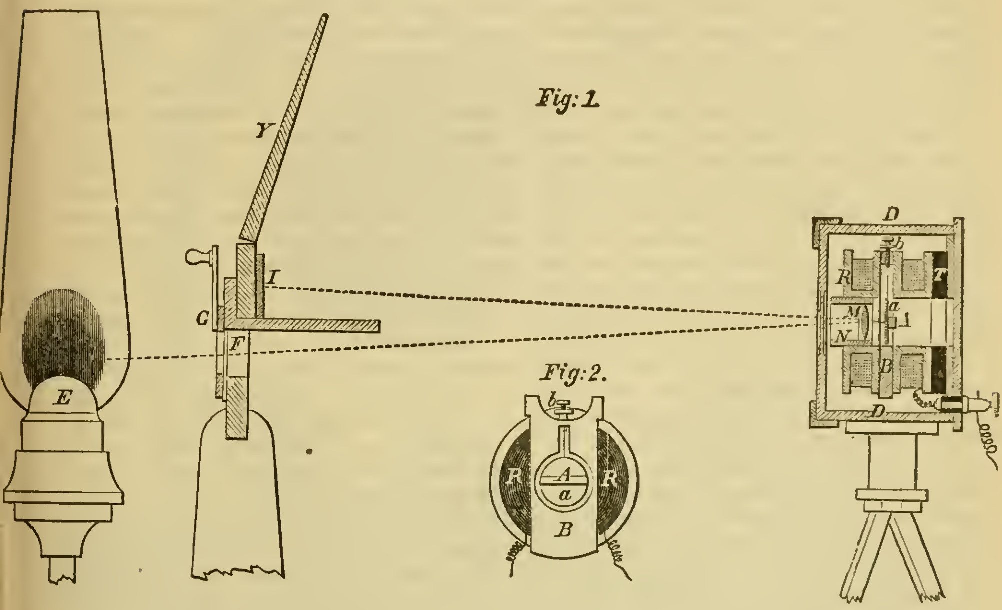



Fig: 2.

g. 1 is a side elevation of the instrument, showing a section through the galvanometer coils, and Fig. 2 a cross section showing the magnetic needle. The same letters refer to like parts in both figures. *A* is the magnetic needle attached to the circular mirror of silvered glass *a*, which is suspended by a thread of cocoon silk in the brass frame *B*, and adjusted by the screw *b*. The frame slides into a vertical groove in the center of the coil which divides it into two parts. The coil and mirror are enclosed in a glass case *D*, in order to prevent the disturbance of the needle by currents of air. The rays from the lamp *E* pass through the opening *F*, which is adjustable by the slide *G*, and passing through the lens *M* in the tube *N* are reflected by the mirror back through the lens upon an ivory scale at *I* as shown by the dotted lines. The scale is horizontal, extending to the right and left of the center of the instrument, the zero point being exactly opposite the lens. The luminous rays of light are brought to a sharp focus upon the scale by a sliding adjustment of the lens.

The operator reads the signals from a point just in the rear of the magnet and coils, the light of the lamp being cut off by the screen *Y* so that he only sees the small luminous slit through which the light enters the instrument, and a brilliantly defined image of the slit upon the white ivory scale just above, which is kept in deep shadow by the screen *Y*. A very minute displacement of the magnet gives a very large movement of the ray of light on the scale *I*, the angular displacement of the ray of light being double that of the needle.

The deepest water encountered was 2,400 fathoms, and the distance between Valentia and Hearts Content 1670 knots. The length of the cables of 1865—1896 knots; 1866—1858 knots.

The battery employed upon the Atlantic cables is a modification of Daniell's. 12 cells are sufficient for signaling. The receiving instrument is Thomson's Reflecting Galvanometer. This consists of a needle formed of a piece of watch spring three-eighths of an inch in length. The needle is suspended by a thread of cocoon-silk without torsion. The needle lies in the centre of an exceedingly delicate galvanometer coil. A circular mirror of silvered glass is fixed to the needle, and reflects at right angles to it in the plane of its motion. It is so curved that when the light of a lamp is thrown through a fine slit on it, the image of the slit is reflected on a scale about three feet off, placed a little above the front of the flame. Deflections to the extent of half an inch along any part of the scale are sufficient for one signal. In so delicate an instrument, the sluggish swing of the needle in finally settling into any position would destroy it susefulness. To rectify this, a strong magnet, about eight inches long, and bent concave to the instrument, is made to slide up and down a rod placed in the line of the suspending thread above the instrument. This magnet can be easily shifted as necessity may require. The oscillations of the needle due to itself are, by the aid of the strong magnet, made so sudden and short as only to broaden the spot of light. The delicacy of even this exceedingly delicate galvanometer can be immensely increased by using an astatic needle.

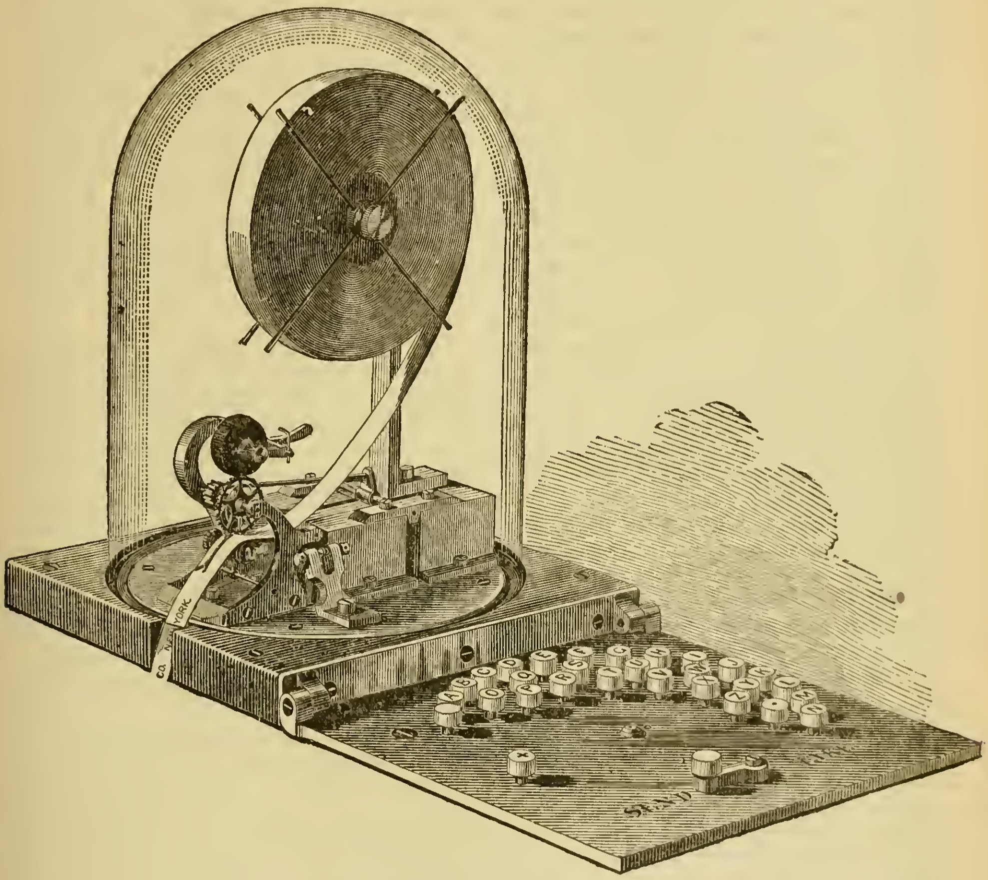
The alphabet is made by opposite movements produced by one or other of two Morse keys. The signals need not be made from zero as a starting point. The eye can easily distinguish, at any point in the scale to which the spot of light may be deflected, the beginning and the end of a signal, and when its motion is caused by the proper action of the needle or by currents. It is thus that the mirror galvanometer is adapted to cable signaling, not only by its extreme delicacy, but also by its quickness. The deflections of the spot of light have been aptly compared to a handwriting no one letter of which is distinctly formed, but yet is quite intelligible to the practised eye. Signals in this way follow each other with wonderful rapidity. A low speed—some eight words a minute—is adopted for public messages; but when the clerks communicate with each other, as high a speed as eighteen or twenty words is attained. This rate of speed soon proved insufficient for the demands of business, and though some modifications were made to increase it, it was found necessary to have more lines; and there are now six lines across the Atlantic, and by the new processes their power is indefinitely multiplied. There are now telegraphic lines to every important point on the globe, and each year is increasing the facilities for communication.

Telegraphic stations must be united by one insulated wire, either carried overland or under the sea. The insulation of land lines is insured by attaching the wires to insulators fixed on posts some twenty feet high. The posts are placed at distances of about sixty yards apart. Insulators are of all shapes and many materials. The insulator most generally used in the United States is made of glass, and is supported by a wooden pin. The leakage in a long line, notwithstanding the best insulation, is considerable. The loss at each post is insignificant, but when hundreds or thousands are taken into account it becomes decided; so that in extremely wet weather in some cases merely a fraction of the total current that sets out reaches the earth.

The wire most employed for land lines in the United States is No. 9 galvanized iron wire, although there is considerable of No. 8, and a few thousand miles of No. 7 and 6 in use.

The first telegraph line constructed in the United States was put in operation in the month of June, 1844, between Washington and Baltimore. Up to this time the electric telegraph had been regarded only as a curious theoretical science without practical application.

As far back as 1834, Messrs. Gauss and Weber constructed a line of telegraph over the houses and steeples of Gottingen, using galvanic electricity and the phenomenon of magnetic induction as a motor. The slow oscillations of magnetic bars, caused by the passage of electric currents, and observed through a telescope, furnished the signals for corresponding, but the operation was complicated, slow, and inefficient. In 1837, M. Steinheil established a line of telegraph between Munich and Bogenhausen, a distance of twelve miles; and in 1838, Professor Wheatstone constructed a line between London and Birmingham, but the apparatus employed by each was crude and unsatisfactory, and it was not until Professor Morse perfected his simple and reliable system, that the electric telegraph became of practical utility.



STOCK REPORTING AND PRIVATE LINE TELEGRAPH

During the first few years after the introduction of the electric telegraph its progress was very slow. Capitalists were afraid to invest in an undertaking so novel and precarious. When one of the most distinguished financiers of New York was asked by the projectors to subscribe towards the construction of the first line from Baltimore to New York, he replied that he would make them a present of a hundred dollars, but that he would not have his name associated as a stockholder in so wild and chimerical a scheme. After the line was completed, this incorrigible skeptic was amongst the first and best patrons of the company.

As a natural consequence of the distrust of capitalists, and the great difficulty of raising funds for properly building the lines, they were constructed in a very unreliable manner and breaks and interruptions was rather the normal condition of the wires than the exception.

At the commencement of 1848, the length of telegraph wire in operation in this country was about 3,000 miles. At the present time (1882) there are more than 270,000 miles in successful operation within the limits of the United States, having over 10,000 stations and employing upwards of 20,000 operators and clerks. The gross receipts of the various telegraph companies in this country amount to upwards of $14,000,000 per annum, while the aggregate capital employed is more than $90,000,000. The number of messages transmitted in a year is now over 32 millions. As the despatches began to multiply it soon became evident that there must be some means contrived for sending messages with greater rapidity without greatly enhancing the cost. This cost was made up of several items: the expense of the plant, including wires, posts, telegraphic machines, stationery, expense of stations, the moist batteries, or at a later period, the dynamo-electric batteries, called for short, dynamos; the cost of repairs, presumably greater with posts than with subterranean tubes; and, heaviest of all, the wages of operators. The first attempt at increasing the facilities was by the multiplication of wires and machines; but this did not materially diminish the cost, as each wire and machine must have its operator. The next was the invention of the duplex and quadruplex methods, by which, at a slight additional expense, the number of messages sent on the same wire might be increased two or four-fold. This saved on the wires, and by enabling an office to quadruple its business diminished the expenses at each office or station, relatively to the amount of work done; but the cost of operating was not yet diminished. The latest improvement is a real advance, the application of the principle of automatism to telegraphy, and its extension to any desired width and length. The messages as brought in are handed over to girls or quick, active boys, who, by the use of a machine much like the type-writer, transfer it to a ribbon of paper, perforating holes in the ribbon representing the Morse alphabet, and writing on the same ribbon twenty or thirty messages. This long ribbon is rolled up like a roll of tape and passed to the transmitter, who reels it off on his machine at the rate of from 800 to 1,200 words in the minute, using two needles which break circuit at every perforation. Twenty messages of the ordinary length can be sent by one operator in thirty seconds, whereas by the old Morse machine they would require at least an hour. The messages are delivered in the Morse alphabet, which must be written out at the office. Mr. Edison has invented a new perforating apparatus, which is in many respects a great improvement on this. His instrument has 28 keys, each marked with a letter or figure, and five rows of perforations are made in the ribbon at once; then, when a key is touched, the perforations making that letter are made on the ribbon and the next letter is taken up. This will transmit, under a good operator, from 250 to 400 words in a minute. The five wires of the transmitter have each a needle point and little wheel at the transmitting end, and five needles at the receiving end, where, touching the chemically prepared paper, they print in blue dots and in smaller size the message received. These printed messages do not require to be copied, but can be torn off and given to the messenger for instant delivery.

Still another invention of considerable promise is Cassells' autographic or fac-simile telegraph, which by an ingenious process transmits the message written with a hard lead pencil, or by a type-writer on common drawing paper, in exact *fac simile* to the other end of the line. Upright revolving cylinders are used both in transmitting and receiving messages by this instrument, the messages being wrapped around them. Of course no copying is necessary here, and the message is transmitted in the same handwriting in which it was written.

The various uses to which the telegraph has been applied are almost innumerable. Amongst the most important of them may be mentioned its application to the running of trains on railroads; the giving of alarms of fire in our principal cities; its employment in scientific and astronomical observations, and the transmission of weather reports. Within the past few years a new field of usefulness has been opened and developed in the application of the telegraph to stock reporting and private line purposes, and in which it has already achieved a very great success, with promise of becoming in the future a still more important branch of the business. The instruments used for this purpose print the dispatches in plain Roman letter, swithout the aid of an operator at the receiving station. Through the aid of this apparatus stock and market quotations are received at the exchanges, banking-houses and other places of public resort in the chief commercial cities of the United States, at all hours of the day. This new enterprise, which was inaugurated in 1868, has become one of the most important features of the telegraphic business.

In December, 1870, a general system of telegraphic money orders or transfers was put into operation in the Pacific States. The public demand for the use of facilities for telegraphic exchange had long been apparent, and had induced the authorization of a limited amount of business, which was conducted with success and profit; but the need was felt of a system which could be adopted generally, without bringing in at the same time new and serious risks. This object has now been attained, and arrangements have been made for opening money-order offices in all parts of the country.

Congress having, by joint resolution, authorized the Secretary of War to provide for taking meteorological observations at various points in the United States and Territories, and for their transmission by telegraph to stations on the Northern lakes and Eastern seaboard, arrangements were made with the Western Union Telegraph Company for the performance of the telegraphic service commencing on the first of November, 1870. Twenty-five circuits are occupied, embracing one hundred and thirty-eight stations, from which three daily reports are transmitted to Washington, copies being also dropped at intermediate stations on each circuit, making an aggregate daily transmission of 50,000 words.

The synchronous transmission, three times per day, of meteorological observations from one hundred and thirty-eight stations, embracing a territory covering 30 degrees of latitude and 67 degrees of longitude, is unparalleled in the history of the telegraph; and the eminently successful manner in which this great undertaking has been performed affords good evidence of the superior condition and operation of the telegraph lines in this country.

On the first of October, 1869, the Western Union Telegraph Company, which operates lines in every State and Territory in the Union, adopted a new Air Line Tariff for the transmission of messages, causing an average reduction of about 15 per cent., and on the first of January, 1870, inaugurated a new feature in telegraphy whereby messages could be received at and for all stations in the United States for transmission during the night, and delivery the next day, at one-half the usual tariff rates.

In Europe the telegraphs, with the exception of the submarine lines, are nearly all owned and controlled by the governments, and in England, Belgium, and Switzerland, they are connected with the postal service. In continental Europe the annual expenditures for the telegraphic service exceed the receipts by about two millions of dollars. In England the telegraphs were purchased by the government in January, 1870. In 1879 the government reported a net revenue, since 1872, from its telegraph lines, of £1,311,685= $6,558,425. It transmitted, in 1879, 23,385,416 messages, almost three times the number transmitted in 1870.

The progress of the electric telegraph within the past sixteen years has been very great in every quarter of the globe. Upon this continent the electric wire extends from the Gulf of the St. Lawrence to the Gulf of Mexico, and from the Atlantic to the Pacific Ocean. Six cables span the Atlantic Ocean, connecting America with Europe, and others unite us with the Queen of the Antilles, and with the South American and Mexican coasts on both oceans. One is also in progress across the Pacific, reaching the Sandwich Islands, Australia, and Japan. Unbroken telegraphic communication exists between all places in America and all parts of Europe; with Tripoli and Algiers in Africa; Cairo in Egypt; Teheran in Persia; Jerusalem in Syria; Bagdad and Nineveh, in Asiatic Turkey; Bombay, Calcutta, and other important cities in India; Hong Kong and Shanghai in China; Irkoutsk, the capital of Eastern Siberia; Kiakhta on the borders of China; Nagasaki in Japan; Havana and all important towns in Cuba, and to New Westminster in British Columbia. But, however rapid the extension of the telegraph has been in the past, it is destined to show still greater advancement in the future. Neither the American nor the European system has yet attained to its ultimate development. The telegraph is already established in various parts of South America, and in Brazil and Peru arrangements are now making for largely extending them.

A direct line of telegraph under one control and management has recently been established between London and India with extensions to Singapore and China, which will soon be continued to Australia.

Europe possesses 450,000 miles of telegraphic wire and 13,000 stations; America 350,000 miles of wire and 20,000 stations; India 44,000 miles of wire and 1,000 stations; and Australia 41,000 miles of wire and 1,000 stations; and the extension throughout the world is now at the rate of 100,000 miles of wire per annum. There are in addition 50,000 miles of submarine telegraph wire now in successful operation, extending beneath the Atlantic and German Oceans; along both coasts of Mexico and South America; the Baltic, North, Mediterranean, Red, Arabian, Japan, and China Seas; the Persian Gulf and the Indian Ocean; the Bay of Biscay, the Strait of Gibraltar, and the Gulfs of Mexico and St. Lawrence.

More than forty thousand cities and villages are now linked in one continuous chain of telegraphic stations. The mysterious wire with its subtle and invisible influence traverses all civilized lands, and passes beneath oceans, seas, and rivers, bearing messages of business, friendship, and love, and constantly, silently, but powerfully contributing to the peace, happiness and prosperity of all mankind.

Professor Morse, who was already past middle age when he conceived the idea of the electric telegraph on board of the packet ship Sully on her ever-memorable passage from Havre to New York, in 1832, and who was nearly three-score years of age when his first line was built, died in 1872 at the age of 81 years, having reaped the rich fruits of a harvest more abundant than falls to the lot of one man in a generation. The invention of Professor Morse, although yet in its infancy, has already conferred inestimable benefits upon the people of more than half the globe without having occasioned a pang of sorrow to a single human being. If he is to be entitled to be esteemed a benefactor who makes two blades of grass to grow where but one grew before, with what honors should we regard him through whom wars have been postponed and shortened, peace promoted and extended, time annihilated and distance abolished, and all the highest and noblest faculties of man multiplied, extended, and enlarged.

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## CHAPTER II.

### TELEPHONES AND PHONOGRAPHS.

The telephone is in its primary signification merely an instrument for transmitting sound to a distance, and the transmission of sound in this way is almost as old as the world itself. The Greeks and the Romans both used means for effecting it, though the distance to which they were able to transmit it was confined within somewhat narrow limits, hardly exceeding those of the speaking tube. A later, though still early invention, was that of the string telephone, by which sound may be communicated through a wire with a membranous disk at either end. Robert Hooke, an English writer in 1667, describes this, and had experimented with it to such purpose as to be able to convey sounds more than a hundred yards. The whispering gallery was another contrivance on a different principle for effecting this result, and in the course of years the string telephone was so far perfected that it would convey sounds for perhaps a half-mile.

But the instrument which has proved so effective and useful is based on another and different principle, or, rather, on more than one. It had long been known that musical sounds can be heard much farther and more completely than ordinary articulation,—and this whether the sounds were loud and strident, or soft and comparatively low. The music of a band, the notes of a piano, violin or guitar, even vocal music, be it ever so sweet and gentle, are heard at a much greater distance than even the loudest words of command. In the old days of slavery, when the field hands were to be called from their work at noonday or evening, the call was made either by the bugle or horn or by the singing tones of some negro child whose musical notes could be heard in the far distant field.

It was natural then that when the electric telegraph had achieved its first triumphs, the attention of not only scientists but of the public should have been turned to the possibility of vocal or at least of musical communication through electric wires. It had been found possible to convey pictures, drawings, and fac-similes, by this means, to distant points, and why should it be impossible to convey speech, or at least songs, in this way? Men of inventive and poetic genius foreshadowed it very distinctly. In a discourse delivered not later than 1853, in his own pulpit, the late Dr. Horace Bushnell, a man of rare inventive faculties, as well as of great imaginative power, used substantially the following language. We quote from memory: "Sound is no more perishable than matter. The ethereal waves, vexed by it, go on in constantly widening circles, throughout the universe, and though to our dull ears 'nor sound nor voice is heard,' yet the prayers of Enoch and Noah, the petitions of Abraham and the sweet songs of David may yet be reverberating in the ears of the Almighty, and be audible to the heavenly host. And the time is coming, perhaps ere this generation shall pass from the stage, when through electric impulses, properly adjusted, we, too, may be able to listen to the voices of prayer and praise in distant cities, perhaps even in distant lands." A year or two later, a French writer, Mr. Charles Bourseul, published a paper on the electric transmission of speech, in which he indicated with great clearness and with precise description, the methods by which at some time not far distant, both vocal and musical sounds could be transmitted over the wires. He had perceived the difficulty which was actually encountered in the invention of the speaking telephone, that while the transmission of musical sounds was comparatively easy, as those sound waves synchronized with the electric waves excited by the musical sounds, the communication of syllabled words was far more difficult from the comparative inflexibility and uniformity of the electric waves — and he had suggested means by which it might be possible to overcome this difficulty.

In the actual invention, of course the musical telephone, or, as perhaps it might be called with more propriety, the musical telegraph, came first. It is generally conceded that Philip Reiss, professor of natural philosophy at Friedrichsdorf, near Frankfort-on-the-Main, Germany, was the first practical inventor of the musical telegraph or telephone. His invention was publicly exhibited in October, 1861, at Friedrichsdorf and Frankfort. This instrument, or rather the two instruments, the transmitter and receiver, differed very little in their general appearance or construction from the Bell telephone; they communicated musical sounds with great fidelity, though with some deficiency of intonation or *timbre*, the sounds being shrill, harsh, and not attractive, but they did not communicate speech with much volume or any natural intonation. It is said, however, that Prof. Reiss and Prof. Vanderweyde, and Messrs. C. and L. Wray, following him in the same line, did produce speaking telephones between 1861 and 1868, but these were by no means perfect, and were far better adapted to the communication of musical sounds than of speech.

Thus far the telephonic inventions had been mostly, perhaps entirely, made in Europe; but the next step forward was made on this side of the Atlantic. The invention of a thoroughly practical musical telephone undoubtedly belongs to Mr. Elisha Gray, of Chicago, and the production of a speaking telephone is a question yet at issue between him and Prof. Alexander Graham Bell, an Englishman (the son of A. Melville Bell, the author of "Visible Speech"), but a naturalized American, and a resident of Salem, Massachusetts. Mr. Gray's first telephone (the musical one) was patented in 1874. On the 14th of February, 1876, Mr. Gray filed a caveat for an instrument to communicate by electrical or galvanic means vocal sounds or conversation through an electric circuit. His description was full and definite and accompanied by drawings which would enable any good mechanic to make a practical speaking telephone. On the same day Mr. A. Graham Bell filed specifications and drawings for a speaking telephone, but though his claims were extensive, the transmitting and receiving instruments he then described and illustrated would not accomplish the result desired. This result he obtained soon after, but by a material modification. Both men recognized the necessity of connecting the sound vibrations of the artificial tympanum, whether membranous or metallic, by which the sounds are transmitted, with the undulatory electric waves or currents, in order to produce distinctly articulated sounds in their own proper *timbre* or natural modulations. Mr. Gray proposed to accomplish this by passing the vibration through some liquid, as water; Mr. Bell by the combination of a permanent magnet or other body capable of undulative action with a closed circuit, so that the vibration of the one should occasion eléctrical undulations in the other, or in itself. The diaphragm or tympanum used for the transmission of sounds by both was at first an elastic membrane, with some metallic plates of platinum or other metal in partial contact with it. Later the steel or other metallic disk, thin and elastic, was substituted for this. With subsequent modifications both these instruments performed very good work, though at first they could not successfully cover a greater distance than from 25 to 50 miles. Owing to some errors of form Mr. Gray's caveat was not followed as soon as it should have been by the specifications for a patent, and Mr. Bell's anticipated it; but the question of priority of invention is not yet fully decided. Both probably invented the telephone independently of each other. Subsequent improvements have enabled them to be heard quite distinctly to a distance of 250 miles or more.

Mr. Thomas A. Edison, whose inventions and discoveries in connection with practical electricity have given him a world-wide fame, about the same time took up the Reiss telephone with the view of improving and rendering it practically effective. He recognized the doctrine of the necessary action of undulatory currents, but instead of employing a liquid conductor, as Mr. Gray had proposed to do, he attempted to use semi-conducting solid bodies, and of these he selected as most suitable, graphite and carbon, and especially carbon produced from compressed lampblack; pencils or blocks of this substance, alternated with platinum and rubber were placed back of the mouth-piece, or, as was afterwards discovered, the substitution of spiral wire springs for the rubber, and of a heavy and comparatively inflexible diaphragm for the thinner one, produced much better effects, rendering the articulations much more distinct and heard at a greater distance. Prof. Dolbear, of Tufts' College, Mass., also invented the telephone independently of Mr. Bell at about the same time, and by the evolution of the same principles, using the permanent magnets in the same way. The telephone has since its invention been improved in a variety of ways. Many thousands of experiments have been made with it for this purpose, by the most expert electricians in both countries. These experiments have had reference to the form and character of the permanent magnets; to the greater or less quantity of the coils with which they are wound; to the form, composition and thickness of the diaphragm which closes the mouth-piece, and to the possibility of entirely dispensing with the diaphragm; to the comparative efficiency of strong and weak currents; to the greater clearness of articulation and distinctness of utterance of the sounds at the place of reception; to the extension of the distance to which sounds may be transmitted with distinctness—this has reached to more than 400 miles; and finally, by some of the inventions of Mr. Edison and others, to the automatic recording and preservation of the sounds at the point of reception, by the receiving apparatus itself. Perhaps the most ingenious and useful of all these inventions have been the microphone and the electro-motograph, the one magnifying and enlarging the sound, the other causing it to be automatically recorded as it passed through the receiver. Prof. Dolbear has also adapted the common string telephone to a Morse sounder or relay, by which speech may be transmitted, the same instrument acting either as receiver or transmitter.

The innumerable uses to which the telephone has already been applied are but a prelude to those to which it will, in its perfected state, be adapted. It forms now a ready and indispensable means of communication between the work-shop or manufactory and warehouse or salesroom, though they may be many miles apart; it has established communication between the interior of coal, iron, gold or silver mines and their offices; between banking-houses and their correspondents in other cities; between the different departments of the government; between the merchant's or banker's office and home; between physicians and their patients: clergymen and their sick or absent parishioners; it is united with the district telegraph system, and so is available for all special calls and the summoning of messengers, police, physicians, etc., etc. Another of its applications is for bringing many vil-

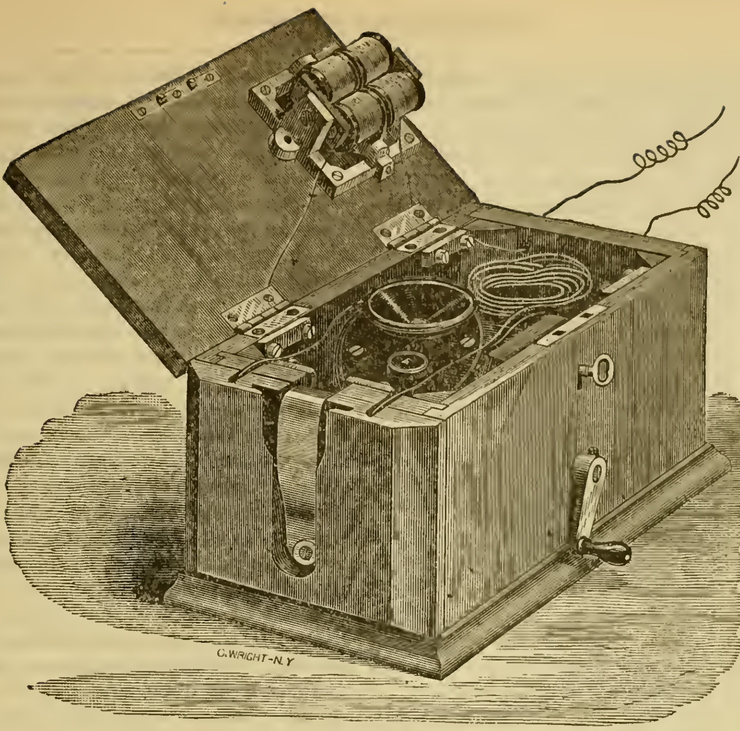



*Fig.* 12.

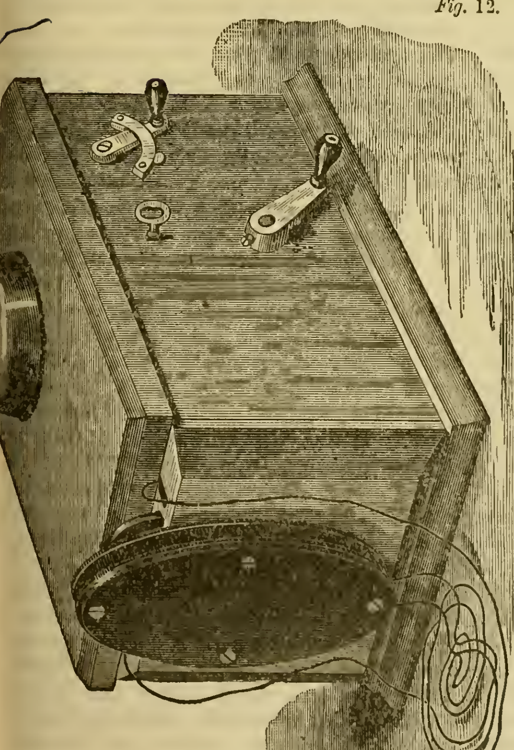


*Fig.* 11.

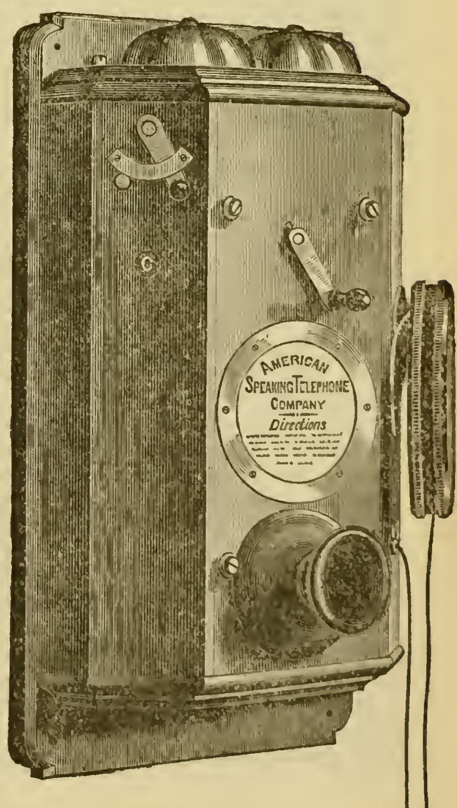



*Fig.* 13.

lages and hamlets which are now destitute of telegraphic facilities into direct connection with them, and at an expense so moderate as to be within the reach of all.

The Talking Phonograph is a natural outcome of the Telephone, but, unlike any form of telephone, it is mechanical and not electrical in its action. There have been many inventions for recording sounds, some of them very perfect, and capable of recording the notes of music or the words of the orator very completely, of course in a language of their own, yet one in which it was possible to read and understand them; but, as it has been wittily said, "None of these inventions could ever talk back," till Mr. Edison produced his Talking Phonograph.

The earliest form of the phonograph was a registering cylinder, covered very smoothly with the best tinfoil, or a very thin sheet of copper; this was set in motion by a winch or crank. Before the register a vibrating plate was placed, furnished on its face with a telephone mouth-piece, and on the reverse side with a tracing-point, which, however, does not rest directly on the cylinder, but on a spring, while a rubber pad is placed between it and the vibrating disk of the mouth-piece. This pad is formed of the end of a tube which is designed to send the vibrations of the disk to the point without stifling them. Another pad placed between the plate or disk, and the rigid support of the point, moderates in some degree these vibrations, which, without this precaution, would generally be too powerful. The cylinder of which the axis is cut in screw-threads at one end, in order to enable it to make a lateral progressive movement, simultaneously with the rotatory movement effected on itself, has a narrow screw-thread on its surface coinciding with that of the axis; and when the tracing point is inserted it is able to pass along it for a distance corresponding to the time occupied in turning the cylinder. The foil, when put on the cylinder, is gently pressed into the groove of the screw-thread, and the point connected with the vibrating disk is placed in a proper position in the groove. The point, once placed at the beginning of this groove, is tightened to the right degree of pressure by a thumb-screw in the lever which holds the disk and mouth-piece. The speaker stands before the mouth-piece as before a telephone or an acoustic tube, and speaks in a strong, emphatic voice, with his lips pressed against the walls of the mouth-piece, and at the same moment he or some one else turns the crank of the cylinder, which has a fly-wheel or balance wheel to make its motion regular. Influenced by the voice, the disk or plate connected with the mouth-piece begins to vibrate, and sets the tracing point at work, which presses on the tinfoil at each vibration, and produces a furrow whose depth varies along its course in correspondence with the unequal vibrations of the disk. The cylinder, which moves at the same time, presents the different portions of the spiral groove to the tracing point in succession; so that when the spoken sentence comes to an end, the design which has been pricked out, consisting of a succession of reliefs and depressions, represents the registration of the sentence itself. If it is desired to reproduce the sentence (and under the cylinder arrangement there was some risk in detaching the foil from the cylinder before reproduction), by a simple arrangement the cylinder was turned aside, the disk and point readjusted to their original position, and the crank is then turned as nearly as possible at the same rate as before, when these depressions in the foil produce the same vibrations as at first, and the words are uttered by the mouth-piece in as nearly as possible the same tones as when they were first spoken. A difference in the speed of the turning of the crank produces some modification in the utterance of the sounds. As the position of talking with the lips pressed into the mouth piece was not a very graceful one for an orator, the turning of the crank was liable to be somewhat irregular, and there was danger that the foil, once removed from the cylinder, could not be replaced exactly upon it, and would in any event be worn out by two or three renderings, the ingenious inventor has modified the machine by substituting an enlarged and funnel-shaped mouth-piece so arranged that the speaker may stand three feet away from it and still produce the same vibrations of the disk; he has substituted a flat plate for the cylinder, and very thin sheets of copper, zinc, or iron for the tinfoil, moves the crank or plate by clock-work, and has provided for the stereotyping or electrotyping of the tracings upon the plate, and their preservation, so as to be reproduced years afterward with the utmost perfection, and this reproduction repeated indefinitely.

This ingenious invention was at first regarded as but little more than a mechanical toy, but in its perfected state it has many uses. A writer in Scribner's Monthly for April, 1878, thus speaks of its employment: "The talking phonograph will doubtless be applied to bell-punches, clocks, complaint boxes in public conveyances, and to toys of all kinds. It will supersede the short-hand writer in taking letters by dictation, and in taking of testimony before referees. Phonographic letters will be sent by mail, the foil being wound on paper cylinders of the size of a finger. It will recite poems in the voice of the author, and reproduce the speeches of celebrated orators. Dramas will be produced in which all the parts will be well spoken, with good accent and good discretion; the original matrice being prepared on one machine, provided with a rubber tube having several mouth-pieces; and Madame Tussaud's figures will hereafter talk, as well as look, like their great prototypes." We may add that in its improved condition, it can reproduce, with all the trills and quavers, the singing of the most accomplished prima donnas.

## CHAPTER III.

### THE ELECTRIC LIGHT.

Since its first production by Sir Humphrey Davy in 1813, the electric light has been brought by the cumulative labors of many inventors from the subject of a mere laboratory experiment to a practical and extensively introduced means of general illumination. Davy was the discoverer of the electric arc, which he produced with a battery of 2,000 cells, causing the current to leap through four inches of air, and producing a heat so intense that it melted platinum like wax, and fragments of diamond placed in the arc were vaporized. It was a brilliant experiment, but the light was too costly for practical use, its expense being about six dollars a minute. The great cheapening of the light during recent years has been accomplished by abandoning the use of galvanic batteries as a source of the current and substituting therefor magneto-electric machines driven by steam, by which not only an infinitely cheaper but far steadier and more constant current is produced. As it is to the development of these machines that the economical success of the electric light is due, their operation will first be briefly described. Each machine consists of one or more powerful permanent or electro-magnets, and an armature, so called, arranged to revolve between the opposite poles of the magnets. The armatures differ with the various types of machines, but are all alike in being of soft iron and wrapped with insulated wire which terminates at a commutator on the armature-shaft, from which the current is taken off by springs or brushes. The machines most in use for electric lighting purposes are of the Gramme type, the characteristic feature of which consists in making the armature in the form of a ring, wound with a continuous coil of wire. This armature was first invented by Dr. Pacinotti of Milan, Italy, in 1860, was afterward re-invented in an improved form by Gramme, and has since been modified and improved by Brush, Maxim, Edison and others. The soft iron ring becomes a magnet by induction, one side presenting a north pole, and the side diametrically opposite presenting a south pole. As the ring revolves, its poles remain stationary, so that every portion of the ring becomes alternately a north and south pole. The coil, by revolving with the ring, has two opposite currents of electricity induced in its two opposite halves, each current starting from a point midway of the two poles, flowing in opposite directions past the poles, and emerging at a point diametrically opposite the starting point. At these starting and emerging points the current is taken off from the commutator or collector on the revolving spindle which bears the armature ring. This type of machine is the only one producing a uniform current in one direction, the other types, as the Siemens, producing a current first in one direction and then in the other, requiring a current-reversing commutator to turn both currents in the same direction, and then supplying a rapid succession of electrical waves, rather than a steady current. If a current of high pressure, known as an intensity current, is desired, the armature is wound with a fine wire, while if a current of quantity, or one possessing slight intensity but great volume is needed, coarse wire is used. The current also depends for its character on the speed of the armature, as an increase in speed increases both the volume and intensity of the current, and consequently also the brilliance of the light. It has been found that the variation in speed occasioned by the flapping of a long belt has affected the steadiness of the light, and hence Edison has adopted the plan of placing the armature on the crank-shaft of the steam-engine which furnishes the motive power. The action of magneto-electric generators has been likened to that of a pump in forcing water through a pipe, but the analogy is far from exact. The power of the steam-engine in forcibly rotating the armature causes a current of corresponding power to flow through the wires of the circuit, and the energy of this current is converted into light by the electric lamp. The resistance of the armature to rotation is so great that it is always more or less heated when revolving, and in powerful machines is often heated to a dangerous extent.

All the numerous varieties of electric lights belong to one or other of two classes; — arc lights and incandescence lights. The former have been longest known, and are by far in the most extensive use, those now in operation in the United States alone numbering into the thousands. When two carbon-tipped wires leading from the opposite brushes of an electric generating machine, or from the poles of a powerful battery, are touched together, the circuit through the wires is closed and the current passes. If then they be drawn slightly apart, the current does not cease to flow, but leaps the intervening space, carrying with it particles of carbon torn from the points, which it heats to incandescence, producing a light of dazzling brilliancy. The focus of this light is in the space between the carbon points across which the current has thrown its bridge of white-hot flying particles, and this luminous bridge is called from its arched shape the electric arc. Its light is the most intense of artificial lights, possessing a whiteness and purity almost rivalling that of the sun itself. The carbon tips waste away rapidly, the consumption of the positive carbon, or that from which the current flows, being about twice as rapid as that of the negative carbon. If the two carbons be held stationary, the breach between them will gradually widen until the intervening resistance becomes greater than the intensity of the current can overcome, when the current ceases, and the light goes out. Hence to maintain a steady light it is necessary that the carbons shall be fed toward each other as rapidly as they are consumed, so that the arc shall be of unvarying length. For this purpose many ingenious regulating devices have been invented.

The light first practically introduced in this country was the Brush, which is an arc light employing two carbon pencils arranged end to end, and the upper or positive pencil fed down as it consumes, by a very simple regulator, enclosed in a casing above the light. This regulator is typical of that in several other electric lamps, and consists of an electro-magnetically operated clutch which lifts or releases the carbon pencil according to the variations in the electric current. When the pencils are too close together the attraction of the magnet causes the upper pencil to be lifted until the arc is drawn out to the proper length and an equilibrium is attained. On the contrary, when the pencils waste away until the length of the arc becomes too great the consequent weakening of the current causes the electro-magnet to release its hold, and the pencil falls a short distance, being immediately checked when it has approached sufficiently near to the lower pencil. The Brush light is of great brilliancy and whiteness, and well adapted for illuminating large spaces. Brush lamps are used in the New York post-office; they light Broadway from 14th to 26th streets, and a cluster of them is suspended on a high pole in Madison square. Recently a tower has been erected at San Jose, Cal., where four Brush lamps are suspended at a height of 200 ft. Each lamp has 4,000-candle power, a nine-horse power dynamo machine is required to operate them, and they are found to light nearly the entire city. Ordinary Brush lamps have about 2,000-candle power, and each lamp consumes nearly one-horse power. The Brush carbons are coated with copper by electro-deposition, to increase their conductivity. Adjacent to the arc the copper is melted off from both pencils, leaving the naked carbon tips projecting. The Brush Company has in New York City a station where five Brush machines are run at an expenditure of thirty-six horse-power, and from which forty lamps are fed, the lamps being arranged successively, all in the same circuit. Each lamp is provided with an automatic cut-out, which acts in case the lamp becomes inoperative, and prevents the breaking of the circuit, and the consequent extinguishment of tho remaining lamps.

The Maxim arc light is also extensively introduced. It differs from the Brush in that the regulating mechanism is run by clock-work and is arranged below the arc, serving to push up the lower pencil as it is consumed. Mr. Maxim is also the inventor of some improvements in the Gramme generator and in many details of lighting systems. His patents are controlled by the U. S. Electric Lighting Co., which also owns those of Weston, Farmer, and other inventors, and is the parent of many local lighting companies, established in different cities.

For light-houses and for use with reflectors, it is necessary that the arc be kept stationary, instead of being permitted to move as the negative carbon is consumed. For this purpose both carbons must be fed toward each other, but the positive carbon must travel with twice the speed of the negative. This is done in the lamps of Duboscq—where the regulator is driven by a train of clockwork, tending to force the two pencils together, but normally restrained by an electro-magnet — and of Foucault, where two independent clockwork trains are used, one tending to force the pencils together, the other to draw them apart, and one or other permitted to operate, according to whether the attractive power of the electro-magnet is greater or less than normal. The latter is a very perfect lamp, but its expense precludes its use for many other than light-house purposes, and its construction is such that each lamp must have a separate generating machine.

The Jablochkoff candle is an arc light of a different type, in which the regulator is dispensed with. The two carbon pencils stand perpendicularly side-by-side, being separated by a wall of plaster of Paris. The arc is formed between these tips, across the top of the wall of plaster, which it heats to incandescence, thereby assisting the brightness of the light, much as the chalk-block lends brilliancy to the calcium light. As the carbon pencils are consumed and burn downward, the intervening plaster wall is also consumed. The unequal consumption of the positive and negative pencils is prevented by the use of alternating currents, or those produced by a Siemens or other similar generating machine having no commutator. The current changes its direction with inconceivable rapidity, so that a steady light is produced. Each candle lasts only an hour and a half, so that to effect a continued illumination it is necessary to burn several in succession. Thus four candles are arranged in a "lantern" so that as each burns out the succeeding one is automatically lighted. The Jablochkoff candle is extensively used for lighting the streets of Paris, where it has attracted much attention, but it is not to be compared with the American continuous current lights for either steadiness or economy.

The Wallace-Farmer light deserves mention for its simplicity and effectiveness. Two blocks of carbon, nine inches long and three wide by one-half inch thick, are set on edge, one above the other. The lower one is fixed in a rectangular frame, and the upper one is attached to a vertically sliding cross-bar, acted on by an electro-magnet above. When the current passes the magnet lifts the upper block one-eighth of an inch, which develops the electric arc between the blocks, at the point where they approach each other nearest. The arc travels back and forth from end to end of the blocks, seeking always the narrowest space, and the upper block is gradually lowered as the two waste away. The carbon blocks last for 100 hours before they need renewing.

The arc light is no longer an experiment, either as regards its practicability or economy. For lighting streets, large halls, factories, railway depots, and other large rooms and spaces, it has amply demonstrated its superiority over all other means of illumination. Light for light, it is much cheaper than gas, which for these purposes it is rapidly superseding. For all large establishments having their own steam-power its economy over gas is unquestionable, and in many cases the users are unable to find that it has occasioned them any added expense whatever. The beautiful whiteness and purity of the electric light constitutes an important advantage over gas light, especially in stores where the colors of fabrics are to be compared, and in art galleries where paintings are on exhibition. But for small rooms, offices, and dwellings the arc light is utterly unsuited, its great intensity causing it to dazzle and fatigue the eyes, and the contrast between the brilliantly illuminated high lights and the deep black shadows which it throws producing an abrupt and unpleasant effect. Furthermore, it requires almost daily renewal of the carbons, and frequent inspection by an expert.

The incandescent system of electric lighting is designed to overcome these objectionable features, and provide a mild, diffused, and brilliant light for household use. When any part of an electric circuit is inadequate to carry the current supplied, a portion of the current becomes lost, being converted into heat where the defect exists. In this way a fine wire becomes heated to a red or white heat by an intense current, and may be fused if the current be sufficiently strong. Platinum wire, whose melting point is very high, may be kept at a white heat for hours in this way, before it is consumed, and will give forth considerable light. It is this principle which is availed of in the incandescent electric lamps, except that a slender thread of carbon is substituted for the platinum wire, and it is enclosed in a sealed glass bulb from which the air is excluded. Lamps of this character were invented many years ago, but were not reduced to a practical success. The honor of their development to their present stage of perfection must be accorded chiefly to Messrs. Edison, Maxim, Sawyer, and Man, all American inventors, who have labored independently toward a nearly identical solution of the problem. The Edison lamp consists of a loop of carbonized bamboo fiber, scarcely thicker than a horsehair, enclosed in a small glass bulb from which the air has been drawn by mercury pumps so as to produce an exceedingly attenuated vacuum. The ends of the carbon loop are held by copper clamps soldered to two platinum wires which pass out through the neck of the bulb, and are fused into the glass so as to make an air-tight joint. The platinum wires as they emerge through the neck are joined to the positive and negative wires of the circuit, so that a current is caused to pass through the carbon loop. A current which heats the loop to 1000° renders it red, and one which heats it to 2000° raises it to incandescence, and causes it to give forth a beautiful steady white light of usually 16-candle power, or considerably brighter than a large gas flame. A current of this power would instantly consume the slender carbon thread if it were in the open air, but as it is in an almost perfect vacuum, where there is no oxygen to support the combustion of the carbon, the latter will endure for more than 1000 hours before it is disintegrated. Mr. Edison works these lamps in what he calls "multiple arc," that is, the circuit from the generator is divided into as many separate branches or loops as there are lamps, and one lamp is interposed in each branch. By this means the desired subdivision of the light is attained, and each lamp burns independently of the others, much as though it was supplied by a separate machine. Mr. Edison proposes to establish a central station, where a number of his dynamo-electric machines will be operated, and to carry the current therefrom through large conducting mains laid in pipes under the streets, and tapped at frequent intervals by wires leading into the houses of the subscribers. In each house a meter invented by him will be placed, and from thence wires will lead to the several lamps. Mains are now being laid in New York city, to make a practical trial of this system, but until this trial has been made it cannot be definitely determined whether the Edison system is able to successfully compete with gas for lighting dwellings and offices. It is probable that many improvements in details have yet to be made, especially in the customers' meters. Mr. Edison's dynamo-electric machine is peculiarly adapted to lighting by "multiple arc," where the resistance on the circuit is exceedingly small, and an immense quantity of current is required. Instead of wrapping the armature-ring with wire, he uses thick naked copper rods, arranged out of contact with each other, and connected at their ends to insulated disks. The ring itself is built up of many rings of sheet iron, separated by tissue paper. His large machine at the Paris Electrical Exposition of 1881 is built on the same frame with a 125 horse-power engine, the combined weight of engine and generator being 20 tons. With a speed of 350 revolutions per minute this machine is capable of feeding 2,400 lamps.

The Sawyer and Man lamp was a predecessor of Edison's, but has not been brought to an equal perfection. It consists of a slender carbon pencil enclosed in a hermetically sealed globe, filled with nitrogen gas. This gas being a non-supporter of combustion, the consumption of the carbon is prevented. The lamp is somewhat cumbersome and expensive as compared with the Edison and Maxim lamps. Mr. Sawyer has done much toward the perfecting of the electric light, his inventions including safety devices, regulators, commutators, etc.

The Maxim lamp employs a hair-like filament of carbon enclosed in a hermetically-sealed bulb which contains rarefied hydro-carbon vapor. This lamp is being introduced by the U. S. Electric Lighting Company, for offices, factories, steamboats, etc., and it certainly gives a remarkably beautiful and brilliant light, perfectly white and steady. The lamps are worked in multiple arc at about 35-candle power, by a Maxim generator which is governed so perfectly by a regulator that it adapts its current exactly to the needs of the circuit, be there one or many lamps ignited. This light gives as close an approach to daylight as can be imagined. It has been introduced on several ferry boats plying the North river between New York and Jersey City, to the eminent satisfaction of the passengers.

Incandescent lamps can be operated by either continuous or alternating currents, but are less economical, light for light, than the arc lamps. One horse-power gives about ten times as much light in an arc as in incandescent lamps, but the latter are more available for many purposes, and their light is far superior to that of the arc.

The recent development of the Faure accumulators or secondary batteries which can be charged by dynamo-machines operated irregularly or only at intervals, as by wind-power or when connected with other machinery, but which when so charged give out a constant current, promises to increase the applications of electric lighting. Thus a train of five cars has been lighted with Edison lights fed by these accumulators.

In the electric light a new and rapidly growing industry has sprung into being, and is making its influence felt over all the civilized world. It gives employment to thousands of workmen, it has made fortunes for scores of deserving inventors, and it is conferring immeasurable benefits on the public at large. The electric light is forcing its way into popular use despite the opposition of the prejudiced and the arguments of the skeptical. Its advancement and development enlist the efforts of the most skillful, enterprising, and energetic men, and its universal adoption means the antagonism of the powers of darkness and the enlightenment and progress of the world.

## CHAPTER IV.

### ELECTRIC LOCOMOTION.

The idea of driving a vehicle by electric power is not a recent one. Over forty years ago Professor Charles G. Page built an electric locomotive driven by the current generated by a galvanic battery which it carried. But the consumption of zinc in a battery proved too expensive a source of power, and the experiment was abandoned.

The wonderful progress of recent years in the production of electric currents by dynamo-electric machines driven by steam, and the degree of cheapness thereby attained, have awakened new interest in electric locomotion, and two electric railways have been built and successfully operated. In these Page's plan of generating the electricity on the electric locomotive, as steam is generated on steam locomotives, has been departed from, and the principle of a central depot or factory for producing the electric power has been substituted. In this factory are one or more large dynamo generators, driven by powerful steam-engines. From the opposite poles of the generators two insulated wires lead to the railway track, where they are connected one to each rail. The rails are spiked to wooden ties, care being taken to keep them insulated from each other. The wheels of the cars are insulated from their axles, in order that the current may not escape from one rail to the other through the wheels and axles. The locomotive or driving car is provided with an electro-motor geared to its driving-wheels, so that a current through the coils of the motor will cause it to revolve and so propel the car. This motor is a miniature of the generator at the electric factory, and its terminal wires are connected through a commutator with the wheels on the opposite rails. The operator or conductor, by working this commutator, can interrupt the current, or reverse the direction of its flow through the electro-motor, thereby stopping the dummy or running it backward, at will. Electric brakes are also provided to be applied by a manipulation of the commutator.

The honor of the invention of the electric railway must be divided between Mr. Edison in America, and Messrs. Siemens and Holske in Germany. Mr. Edison's road at Menlo Park is about three miles long, and presents many sharp curves and heavy grades, some of the latter being as steep as forty feet to the mile, and on it a speed of over fifty miles per hour has repeatedly been attained with a dummy and two cars carrying several passengers. The speed is under perfect control of the conductor, and the motion on a smooth track is easy and uniform. The generator is the same used with Edison's lights, and over seventy per cent. of the power of the engine working it has been utilized in driving the cars. The leakage of electricity from the rails has occasioned a loss even in wet weather of less than five per cent. These results for an experimental road are certainly remarkable, and point to even more economical working when applied to actual every-day use.

The railway of Siemens and Holske is laid in Berlin and is about one and a half miles in length. The generator is a Siemens dynamo driven by a rotary engine. A Siemens electro-motor is placed beneath the floor of the car, which seats 12 and carries 20 passengers, and makes a speed of from nine to twelve and a half miles an hour, being limited to the latter speed by the authorities. This road has been in operation since May, 1881.

Another plan of Siemens is to provide a separate rail for carrying the current to the car, using the track rails only for return conductors. This increases the expense of the road-bed, but avoids the necessity of insulating all the wheels from the axles.

At the Paris Electrical Exposition of 1881 an electric railway was established by Siemens and Holske, but its operation was imperfect. The current was conducted to the car by a wire suspended over the track, and brushed by a conductor on the roof of the car, the rails serving only as return conductors.

Electric locomotion is yet in its extreme infancy, but it seems to have a brilliant future before it. It is especially adapted for elevated railways, the electric dummy being of light weight, cleanly, noiseless, emitting no smoke or poisonous gases, and requiring only one attendant. The same current which supplies the motive power may also feed electric lamps to light the trains.

The invention of the secondary battery or accumulator, by which the current from a powerful dynamo machine may be stored up for future use, has suggested to many the running of cars and boats by the current discharged from such accumulators. The latter would be charged successively at a central generating factory and loaded into the car, being there connected in circuit with the electro-motor, and exchanged for freshly charged ones as fast as exhausted. A street car has been run for some distance in this way, and recently a small boat has been propelled by a single accumulator, but the results thus far attained are not promising.

# THE SIGNAL SERVICE OF THE U. S.

In all ages and countries, and alike among civilized and savage nations, there has existed a strong desire to know and to predict with certainty the condition of the weather for hours, days, weeks, or months in the future; and in all countries there have been those who, from greater shrewdness in observation, or from experience and observation combined, have been able to foretell with considerable certainty the near approach of a storm, or the probability of fair weather. In many civilized countries, the results of these observations have been put into the form of weather proverbs. Among savage nations the office of the rain-maker or weather prophet is one of great profit and influence, but also one of considerable danger, as, if his predictions prove false, his indignant countrymen are very apt to manifest their displeasure by putting him to death.

All these observations and hap-hazard predictions, however, had evolved no laws or general principles, on which the approach or retreat of a storm could be predicted. They covered only small local areas, and often what was true of one town, or limited district, would be false concerning the next. Careful scientific observers have been engaged since the latter part of the last century in the endeavor to work out from their manifold recorded observations of the course of the winds, of the rising and falling of the barometer, the changes in the sun's surface, and the temperature, some laws which could be relied upon as governing the weather and which could enable men to foresee approaching storms in time to prevent great injury from them. But for many years their search seemed to be in vain. No sooner had they deduced the existence of a cycle of recurring storms, than their philosophy was put to shame by a succession of delightful days just when, according to their predictions, Old Boreas should have raged most pitilessly.

The failure of these eminent scientists to discover the laws which governed the changes of the weather was not due to any want of diligence or any lack of care in their observations, but solely to their having overlooked the course of the wind in the storms and its importance as a prime factor in these changes. It was reserved for an able, though self-taught observer of our own country, Mr. William C. Redfield, for many years a resident and active business man of New York City, to deduce the law of storms, and with it the other laws affecting weather changes, from an immense series of observations, gathered from numerous and widely separated stations. Mr. Redfield's attention was first called to this subject after the destructive gale of September, 1821, but he did not make public his conclusions until he had verified them by extensive correspondence and examination of the logs of hundreds of ships which had been caught in cyclones or hurricanes, or had passed through the outer edge of those destructive agencies. His first publication of his observations was made in 1831, in the *American Journal of Science*, and for many years thereafter he gave great attention to the subject, and yearly, or oftener, published the results of his more extended inquiries. In these he was greatly assisted by Lieut. Colonel, afterward Gen. Sir William Reid, Governor of Bermuda and afterward of Malta, whose careful and extended inquiries and valuable assistance entitle his name to be associated with Mr. Redfield in this great and beneficent work.

Mr. Redfield's theory of storms, verified by thousands of observations, was the following: That all violent gales or hurricanes are great *whirlwinds*, in which the wind blows in circuits around an axis either vertical or inclined; that the winds do not move in horizontal circles, but rather in spirals towards the axis, a descending spiral movement externally, an ascending internally.

That the *direction of revolution* is always uniform, being from right to left, or against the sun, on the north side of the equator, and from left to right, or with the sun, on the south side.

That the *velocity of rotation* increases from the margin towards the center of the storm.

That the whole body of air subjected to this spiral rotation is at the same time *moving forward* in a path at a variable rate, but always with a velocity much less than its velocity of rotation, being at the minimum, hitherto observed, as low as 4 miles, and at the maximum 43 miles, but more commonly about 30 miles per hour, while the motion of rotation may be not less than from 100 to 300 miles per hour.

That in storms of a particular region, as the gales of the Atlantic, or the typhoons of the China Seas, *great uniformity exists in regard to the path pursued*, those of the Atlantic, for example, usually issuing from the equatorial regions eastward of the West India Islands, pursuing, at first, a course toward the northwest, as far as the latitude of 30°, and then gradually wheeling to the northeast and following a path nearly parallel to the American coast, to the east of Newfoundland, until they are lost in mid-ocean; the entire path, when delineated, resembling a parabolic curve, whose apex is near the latitude of 30°.

That *their dimensions* are sometimes very great, being not less than 1,000 miles in diameter, while their path over the ocean can sometimes be traced for 3,000 miles.

That the *barometer*, at any given place, falls with increasing rapidity as the center of the whirwind approaches, but rises at a corresponding rate after the center has passed by; and finally,

That the phenomena are more uniform in large than in small storms, and more uniform on the ocean than on the land.

The application of these principles to the ordinary changes of the weather was not arrived at for several years; but when the electric telegraph was put in operation, Mr. Redfield was prompt to see the advantages it offered for extending the benefits of this discovery to the preservation of life and property, and, early in 1846, he began to urge upon the attention of the scientists of the nation the possibility of using the electric telegraph in connection with the daily study of the weather, for the purpose of forewarning endangered parts of the approach and force of storms.

In his memorable paper published that year in the "*American Journal of Science*," he said: "In the Atlantic parts of the United States, the approach of a gale, when the storm is yet on the Gulf of Mexico, or in the Southern and Western States, may be made known by means of the electric telegraph, which, probably, will soon extend from Maine to the Mississippi." He significantly added: "This will enable the merchant to avoid exposing his vessel to a furious gale soon after leaving her port. By awaiting the arrival of a storm, and promptly putting to sea with its closing winds, a good offing and rapid progress will be secured by the voyager." It is now about twenty years since the late gifted and lamented Admiral Fitzroy put this original suggestion of Mr. Redfield into execution, and by the sagacious application of the laws of storms which we have already detailed, placed his country under such perfect meteorological surveillance, that after a single year's experiment it was officially stated at a meeting of the shareholders of the Great Western Docks at Stonehouse, Plymouth, that "the deficiency (in revenue) was to be attributed chiefly to the absence of vessels requiring the use of the graving docks, for the purpose of repairing the damages occasioned by storms and casualties at sea." In that movement England was followed by France, Prussia, Austria, Holland, Sweden and Norway, Italy, and Russia.

Meanwhile, observations on the hurricanes of the Atlantic had been prosecuted in this country with great care and thoroughness, since the death of Mr. Redfield in 1857, by his son, Mr. John H. Redfield of Philadelphia, and by other eminent meteorologists, Loomis, Ferrel, etc.; but the time had come for its further practical development. In 1870, Congress, on the earnest recommendation of Gen. W. W. Belknap, Secretary of War, passed an act authorizing the establishment of a system of daily weather signals. The organization and management of this service was entrusted to Gen. A. J. Myer, Chief Signal Officer U. S. A., to whose skillful and well directed labors its success has been largely due. It is now known as the office of the Chief Signal Officer, and has ten divisions, all occupied with collecting, receiving, arranging, tabulating, mapping, and distributing the daily and nightly, weekly, and monthly reports received from more than 1200 observers in all parts of the world. It has at its command not only the telegraphic system of the United States and Canada, but portions of that of the West Indies and Mexico, and the Atlantic and other cables, and a telegraphic military line belonging to the service, and wholly under its control, extending, in 1881, 5,077 miles.

General A. J. Myer died August 24, 1880, and was succeeded in the following winter by Brig. and Brevet Maj. General W. B. Hazen, who is now its head.

Let us now give our readers an account of the processes by which these weather predictions, whose accuracy has already astonished the world, are worked out.

The law of Congress imposes upon the Signal Officer the duty of reporting as widely as possible the meteorological conditions of each full station in the United States and Canada three times each day by Washington time, viz.: at 7.35 A. M., 4.35 P. M., and 11.35 P.M. Besides this they give danger signals of approaching storms, high water from all the river stations, farmers' bulletins, the track and approach of storm centers, and predictions of the weather for the next 24 or 48 hours.

The reports received at Washington daily from all sources in 1881 averaged 1221, each one requiring considerable study. By a carefully arranged system of telegraphic circuits, copies of the full reports of all stations are sent at the same time to the signal service stations in most of the principal cities and towns, and at each station so receiving, a tabular report or bulletin is immediately displayed for general use and information. In most of these offices there is a small printing-press, and the type for the report is kept standing, except the moderate amount of alteration necessary. The corrections are put in instantly on the reception of the report from Washington, and copies struck off and sent to the newspapers, exchanges, chambers of commerce, and other important public places, where they are posted for general information. This is generally accomplished between 9 and 11 A. M., 6 and 8 P. M., and 1 and 3 A. M. These bulletins are known as the "morning report," "afternoon report," and "midnight report," and give, in the official signal service report, beside the general synopsis of the weather at the time and the probabilities for the coming twenty-four hours, the following particulars: the height of the barometer and its oscillations since the last report, in the principal stations throughout the country; the thermometric range and variation at the same points during the previous twenty-four hours; the relative humidity of the air, the direction of the wind, the velocity of the wind in miles per hour, the pressure of the wind in pounds per square foot, the force of the wind reduced to the Beaufort or marine scale, the amount and character of the clouds, the rainfall since the last report in inches and hundredths, and the general state of the weather, with any noteworthy particulars. If a storm is approaching and it is found necessary to order cautionary signals hoisted at any given point or points, that fact is clearly stated at the close of the report. All these reports are furnished to the newspapers without cost.

The next step was the preparation of general weather indications and reports. For this purpose the following charts were prepared tri-daily in the Washington office, combining every important point in all the local reports.

(*a*) A chart of barometric pressures, temperatures, winds (direction and velocity), the state of weather, and the kind and amount of precipitation at each station. (*b*) A chart of dew points at all stations. There is also entered for each station the depression of the dew-point below the temperature of the air. On this are traced lines showing each five degrees of equal depression of the dew-point. (*c*) A chart of the various cloud-conditions prevailing at the time over the United States, with the "weather" at each station depicted by symbols; also once daily the minimum and maximum temperatures. (*d*) A chart of the *normal* barometric pressures, and of variation of the actual (corrected for temperature and instrumental error) from the normal pressures. (*e*) A chart of actual changes of pressure occurring, showing separately the fluctuations of the atmosphere during the previous eight and twenty-four hours. (*f*) A chart of normal temperatures and of variations of the actual temperatures from the normal temperatures. (*g*) A chart of actual changes of temperature in previous eight and twenty-four hours. All these charts, each covering the whole of the country, must be made out, and the errors of data they embody sifted and analyzed, preliminary to the preparation of every one of the tri-daily bulletins issued from the central office. Armed with this charted material, the officer preparing the predictions proceeds first to compile the "Synopsis," and then to deduce the "Indications," and issue the storm-warnings. The "Synopsis," "Indications," and cautionary signals constitute the "Press Report," which, when finished, is telegraphed direct from the office of the Chief Signal Officer to all parts of the country. The average time elapsing between the simultaneous reading of the instruments at the separate stations scattered over the United States and the issue of the "Synopsis" and "Indications," based on these readings, has been calculated at one hour and forty minutes.

The verification of predictions made by the office has averaged within the last three years 90.7.

*River Reports.* The important work of observing and reporting the fluctuations and floods of the great western rivers was at an early period of its history undertaken by the Signal Service. These observations were found of so much importance that they have been extended over the Western, Southern, and California rivers, and deductions made from them, indicating impending changes, are daily published in the Washington weather-reports. All measurements at each river-station are made from the "bench-mark," as known to the river-men of the vicinity, and the reading of the gauge is daily telegraphed to the central office, and all other interested stations. Knowing from such telegrams the height of the river at each station, as well as the total amount of reported rainfall higher up the river valley, the office is thus enabled to calculate and announce the time and degree of coming changes.

During the flood-months the telegraphic river reports are especially valuable to all river-shipping and to all interested in the traveling and transportation facilities which depend upon it, as well as giving timely warnings of ice-floods or sudden rises and falls. The levee systems of the Mississippi and other great rivers are thus guarded, and the immense agricultural interests secured, as the flood-warning comes in time to summon the State force to strengthen the imperiled works. Besides, these surface and bottom water-temperatures at points upon the rivers, lakes, and sea-coasts are observed and reported for the U. S. Commissioner of Fish and Fisheries, with a view to ascertain the proper waters in which to plant the various food fishes and furnish statistics desired for the development of the national system of pisciculture. There is also to be mentioned the attention given by the office to the changes of temperature by which the canals are closed by freezing, or opened by thaws for transportation. Such information protects the public from the imposition of excessive railway rates in the shipment of the grain crops, especially in any autumn season of protracted mildness, and effects a large saving to the mercantile world. The Chief Signal Officer, by an arrangement with the different railways, has established a "Railway Weather Bulletin Service." In this work 111 railway companies, distributing daily 3,195 reports to as many railway stations, are now co-operating without expense to the government. The midnight report, exhibiting the "Indications," is telegraphed to the railway companies, whose superintendents are charged with seeing that copies of it are bulletined and posted along their lines a few hours after it emanates from the Washington office. By this means the railroad officials, and residents of districts which cannot otherwise be reached in time, secure the benefits of the Government Weather Service.

*The Cautionary Storm Signals,* which accompany the "Synopsis" and "Indications" issued to the press three times each day, constitute a very important part of the Signal Service work; and it was the possibility of preparing such storm-warnings for the benefit of navigation that originally gave the chief stimulus to the establishment of a Weather Bureau.

The cautionary signals are of two kinds. 1. Those premonishing dangerous winds to blow from any direction. 2. Those premonishing off-shore winds, likely to drive vessels out to sea. Both kinds are needed by mariners as the storm-centers approach or depart from a maritime station. The first, distinctively termed the "Cautionary Signal," consists of a *red flag* with a *black square* in the centre, for warning in the daytime, and a *red light* by night. The second or "Cautionary Off-shore signal," consists of a *white flag* with black square in the center shown above a red flag with square black centre by day, or a *white light* shown above a red light by night, indicating that, while the storm has not yet passed the station, and dangerous winds may yet be felt there, they will probably be from a northerly or westerly direction; this second signal when displayed in the lake region in anticipation of high North to West winds is designated the "Cautionary Northwest Signal."

*Signal Service Instruments.* The necessity for accurate observations in a system of weather-telegraphy brings us to speak of the instruments employed by the Signal Service Corps. These have been selected from the best models known, and subjected to experimental tests to perfect their registrations. Every barometer, thermometer, or other instrument used at the stations undergoes thorough comparison with the highest standards before it is sent out from the Office of the Chief Signal Officer, in which there is a large apartment devoted to this work, known as the "instrument and model room."

Fortin's barometer, as manufactured by Mr. James Green of New York, is the one used by the Signal Office at all its stations. Two barometers are supplied to each station. Great care is taken in the location, correction, and reading of the service thermometers. The open air thermometers, the maximum and minimum thermometers, are all tested, and the slightest variations from the standard instruments determined by protracted experimentation, to the satisfaction of the office, before they are issued to the observers. The rain-guages employed are of a uniform pattern, and register the amount of precipitation to inches and hundredths of an inch. The wind-velocity measurer or *Anemometer,* which up to the present time has been found the most satisfactory, is that of Robinson. The Signal Service has endeavored to obtain barometers, thermometers, etc., which will be self-recording, and give without manipulation continuous, exact, and graphic registers of the atmospheric fluctuations. Numerous ingenious contrivances have been for years under careful testing by the office, with the view of securing forms adapted to general use on stations. As early as July 1, 1878, in connection with the daily International Bulletin, Gen. Myer began the daily publication of a graphic *synoptic "International Weather-Map."* This chart covers the whole international network of observations, and is the supplement and key to the Daily Bulletin, both being based on the same data, and both of the same date. The number of marine observers is 239, and all navigators are requested to contribute to this system of reports.

The Sea-coast Telegraph Lines are another important portion of the organization. The coast signal-stations aim to warn vessels within signaling distance of the approach of the storms, and to give life-saving stations quick notice of marine disasters calling for rescue, as also to furnish any intelligence to the latter, or to the light-houses, which may insure their more efficient working.

*The Signal Service Military Telegraph System,* constructed, owned, and operated by the Signal Service, covers, however, a much larger area than the sea-coast mentioned. In pursuance of acts of Congress, this service has now completed in the interior and upon the frontier an extensive network of telegraphic lines for connecting military posts, with a view to the protection of the population from Indian depredations, and the condition of meteorological, military and other reports to the Government. A total length of 5219 miles of frontier-line is now operated and maintained by the Signal Corps. This connected system of telegraph lines is one of the most effective safe-guards against Indian raids and war-like movements, since it enables the scattered military forces of the United States to obtain timely notice of such movements, and to concentrate quickly at any threatened point to repel attack.

The plan of exhibiting as widely as possible in the agricultural districts the printed forecasts of weather, in the form of a Farmer's Bulletin, meets with increasing approbation and success. With the co-operation of the Post-Office Department, six thousand six hundred and seventy-two of these bulletins are distributed to as many post-offices daily, except Sunday. In addition to the weather synopsis and forecasts printed on this bulletin, it also contains a summary of the general laws accompanying weather changes in the United States, condensed notes of facts relating to the climatology of the different sections, the rain and dry winds, for each month, for the geographical district in which the bulletin is displayed, and diagrams showing the cyclonic and anti-cyclonic movements of winds. These simple foot notes have a remarkable effect in reducing the loss and increasing the gains of harvesting. The Railway Bulletin Service is a rapid and excellent means of disseminating the weather indications issued from the office. This service is established on the lines of prominent railway companies that receive, by telegraph, daily, at 1 A. M., a copy of the Synopsis and Indications. This report is at once distributed, under the direct supervision of the superintendents, to designated stations along the lines. Ninety-three companies, with a total of *two thousand nine hundred and thirty-seven stations*, are now co-operating in this service. The reports received at stations are immediately displayed for the public benefit. Among the improvements made and new and progressive labors undertaken during the past year (1881), may be enumerated the following:

1. The establishment of a permanent School of Instruction at Ft. Myer.

2. The raising of the standard of the *personnel* of the Signal Corps.

3. The systemization of the duties of the Signal Service.

4. The preparation of new instructions for observers of the Service.

5. The preparation of new and improved forms for the recording and preservation of meteorological data.

6. The preparation of special bulletins for the press.

7. The forecasts of weather, of hot and cold waves for periods exceeding twenty-four hours.

8. The forecast of "northers" for the interior plateau.

9. The adoption of a new storm signal for the interior lakes.

10. The arrangement for an increase in the river service and the wider publication of warnings of floods or ice gorges.

11. The changes and improvements in the publication of the International Bulletin and Weather Review.

12. The increased information added to the Farmers' and Railway Bulletins.

13. The organization of a service for the benefit of the cotton interests of the South.

14. The extension of the special frost warning to the fruit interests of the country.

15. The investigations into thermometric standards and into barometric standards.

16. The preparation of new hygrometric tables.

17. The revised determinations of the altitudes of Signal Service stations.

18. The computation of monthly constants for the reduction of observed barometric pressures.

19. The arrangements for original investigation in atmospheric electricity.

20. The arrangements for original investigation in anemometry.

21. The arrangements for original investigation in actinometry, especially with reference to the importance of solar radiation in agriculture.

22. The co-operation in an expedition to the summit of Mt. Whitney, Cal., for the determination of problems in solar physics.

23. The preparation of conversion tables for English and metric systems.

24. The co-operation in the dropping of time-balls at Signal Service stations.

25. The publication of special professional papers.

26. The organization of State Weather Services.

27. The new investigation of danger lines on western rivers.

28. The organization and equipment of the expedition, for meteorological observation and research, to Lady Franklin Bay, in the arctic regions.

29. The organization and equipment of the expedition, for meteorological observation and research, to Point Barrow, Alaska.

30. The establishment of a system of stations of observation in Alaska.

31. The arrangements for organizing a Pacific Coast Weather Service.

32. The arrangements for the Signal Service display at the Electrical Exposition at Paris.

33. The experiments for improving newspaper weather charts.

34. The arrangements for an increase of telegraphic weather service, exceeding in value $34,000 per annum, without additional expense.

35. The extension of the military telegraph lines.

*Conclusion.* In concluding this necessarily much condensed sketch of the national weather-service, its pressing wants should not be overlooked. No other service appeals so strongly to the interests which it daily subserves for intelligent co operation. The public press can do much to advance its development by systematic republication and explanation of its observations and deductions, and especially by reproducing the data furnished in its "Monthly Weather Review," and in the daily telegraphic "Synopsis." Time and toil are necessary to harvest the fruit of seeds sown; but, as the President of the American Geographical Society, Chief Justice Daly, has said,

"Nothing in the nature of scientific investigation by the national Government has proved so acceptable to the people, or has been productive in so short a time of such important results, as the establishment of the Signal Service Bureau."

# AGRICULTURE IN THE UNITED STATES.

I suppose it will be conceded that agriculture is the largest and most important interest of this country. It is my purpose to trace its progress from the time of the establishment of the first settlements upon these shores, but more especially during the last hundred years. If I mistake not, a sketch of its history will be found to possess much that is interesting, useful, and instructive.

It is not necessary to dwell upon the condition of America at the time when it was first settled by Europeans. The character and the objects of the men who proposed to establish a home here, are already familiar to the mind of every intelligent person. They left countries which were considerably advanced in civilization, and better cultivated, probably, than any others, at that time, on the globe, with the exception, possibly, of the Chinese empire. They came to settle down in circumstances wholly new to them, with a climate and soil unlike any which they had known before. They were to begin life anew, as it were, where their previous experience could afford them little or no aid, in a wilderness which was to be subdued by their own hands, in the midst of a thousand obstacles.

With the exception of some extensive tracts of prairie, chiefly confined to the great west, then wholly unknown and inaccessible, there was no large extent of territory which was not covered with the primeval forest, though here and there a partially cultivated opening occurred, which was, or had been, occupied by the Indians. They were, therefore, to start anew; to acquire, painfully and laboriously, that practical knowledge of their new situation, for the details of which no previous training could have fitted them. When we consider the hardships they had to encounter, especially that portion of them who had to endure, year after year, the rigor of a northern winter, we cannot wonder that their progress in farming was slow.

It is true, the different colonies, as they were originally established, had a somewhat different experience. The winters of Virginia were less severe than those of New England. The settlers on the James river suffered less, probably, than those further north, but all had to undergo many privations which are unknown to an old and improved country. All were surrounded by a howling wilderness, by savage men, by wild beasts ready to prey upon their live stock, or destroy their crops. In these respects the circumstances of the settlers in all parts of the country were nearly the same.

Let us look, for a moment, at the condition of things in the Plymouth colony, and we can gather therefrom a pretty correct idea of that in the other settlements. For many months after the arrival of the pilgrims at Plymouth, they had no beasts of burden, and when at last a few cows were brought over, they were poorly fed on the coarse wild grasses, and they often died from exposure and want of proper food, or fell a prey to the wolves or the Indians. Owing to the difficulties and expense of importation, the price was so high as to put them beyond the reach of many, even in moderate circumstances. In the colony of the Massachusetts Bay, a red calf soon came to

INDIAN ENCAMPMENT.

THE FARM.

be cheaper than a black one, on account of the greater liability to be mistaken for a deer and killed by the wolves. When cows were so high as to sell, in 1636, at from twenty-five to thirty pounds sterling, and oxen at forty pounds a pair, a quart of new milk could be bought for a penny, and four eggs at the same price.

It is important to bear in mind that the cattle of that day, even in England, were not to be compared with the beautiful animals now to be seen there. The ox of that day was small, ill-shaped, and in every way inferior to the ox of the present time. The sheep has, since then, been improved to an equal, or even greater extent, both in form and size, and in the fineness and value of its wool. The draught-horse, so serviceable on the farm, long the pride of London, and now, to an almost equal extent, of most of our large cities, was not then known. It is difficult to appreciate fully the changes which the increased attention to agriculture has effected in our domestic animals, even within the last half century.

But when we consider that no attention whatever was paid to the culture of the grasses; that very few, if any, of the vegetables, now extensively cultivated as food for stock, were then introduced there; that the introduction of red clover into England did not take place till 1633; of sainfoin, not till 1651; of yellow clover, not till 1659; and of white, or Dutch clover, not till the year 1700; and that the form, size, and perfection of animals depend largely upon a full supply of food and good care when young, we shall cease to wonder, when we are told by the highest authority, that during the early part of the last century the average gross weight of the neat cattle brought for sale to the Smithfield market was not over three hundred and seventy pounds, and that of sheep, twenty-eight pounds; while the average weight of the former is now over one thousand pounds, and of the latter, over ninety pounds.

It is a fact worthy of note in this connection, as it throws much light upon the early farming in this country, that the extensive and practical cultivation of the natural grasses originated here; or, at least, was introduced here long before it was into England. The necessities of our rigorous climate, indeed, compelled attention to this branch of husbandry very soon after the settlement, while the climate of England admitted a greater degree of reliance on the wild luxuriance of nature.

The cattle that first arrived, in 1624, were kept through the long winters on poor and miserable swale hay, or more frequently on the salt hay cut from the marshes, and death from starvation and exposure was no uncommon occurrence, the farmer sometimes losing his entire herd. The treatment of animals now as they were treated during the whole, or nearly the whole, of the first century of the colony, would subject the owner to prosecution for cruelty. This treatment was, in part, no doubt, owing to the poverty of the settlers, but more, probably, to the ideas and practices in which they had been early trained in a different climate.

Besides, on account of the high price of cattle at that period, and the risks to which they were exposed, it is not probable that the settlers selected the best specimens then to be found in England. There is no evidence that they were at all particular in this respect. Nor was the difficulty of procuring agricultural implements the least of the obstacles to the successful pursuit of farming. A few, no doubt, were brought over, from time to time, from the mother country, but all could not obtain them in this way; while the only metal to be had was made of bog ore, very brittle, and liable to break and put a stop to a day's work. Most were made of wood, and those imported were extremely rude in construction, being very heavy and unwieldy, and having comparatively little fitness for the purpose for which they were designed. The process of casting steel was not discovered till the middle of the last century, and then it was kept a secret in Sheffield for some years. The number and variety of implements have been infinitely increased, as we shall see, even within the last half century, to meet the wants of a more advanced state of agriculture, to which, indeed, these mechanical improvements have, in their turn, largely contributed.

Indian corn, pumpkins, squashes, potatoes, and tobacco, were plants which few of the early colonists had ever seen previous to their arrival here, but necessity taught them their value, and they were not slow in adopting the Indian methods of cultivating them. As the general cultivation among the colonies continued much the same for many years, with slight modifications, on the introduction of the European implements, it may not be inappropriate to turn our attention, for a moment, to the agriculture of the natives.

Most of the hard work among the Indians, it is well known, fell to the lot of the women, with the assistance, sometimes, of the old men and little boys. Among their thankless tasks was that of farming, which they carried on to an extent quite remarkable, when we consider the rudeness of the implements with which they had to work, and the circumstances in which they were placed. They had no art of manufacturing metal, and, of course, could have no suitable contrivances for tilling the ground. Their cultivation was not so rude, however, as one would naturally suppose. They made a kind of hoe by tying the shoulder-blade of a moose, bear, or deer, to a stick or pole, and managed to do much of the work with that.

The land, when selected, was cleared by keeping up a fire around the foot of each tree till its bark was so burned that it would die. Then they planted their corn. When a tree fell, it was burned into pieces of such length that they could be rolled into a heap and burned to ashes. In this way, by degrees, a piece covered with wood was wholly cleared. An industrious woman could burn off as many dry, fallen logs in a day as a strong man could, at that time, cut with an axe in two or three. They used a stone axe, made much in the same manner as the hoe above described, to scrape the charred surface of the logs and hasten the burning. This mode of clearing was pretty common among the natives in different parts of the country. Sometimes the tree was first girdled with the axe and thus killed, allowed to become dry, and then burned by kindling a fire around it, as above described. Several of these stone axes, of different sizes, are now in my possession.

The Indians taught the settlers to select the finest ears of corn for seed, to plant it at a proper time, to weed it, and to hill it. They were accustomed to dig small holes four feet apart, with a clumsy instrument resembling the one described, which was made, not unfrequently, of a large clam-shell. Those living in the vicinity of the sea-shore put into each hole a horse-shoe crab or two, or a fish, upon which they dropped four, and sometimes six kernels of corn, and covered it with the implement with which they had dug the hole. The use of fish in the hill as a fertilizer was common, also, in the interior. Beans were planted with the corn after it had come up, and grew up supported by it.

Great attention was paid to the protection of their crops from weeds, while the corn was carefully guarded from destruction by insects and birds. To prevent loss by the latter, a small watch-house was erected in the midst of a field of corn, in which one of the family, often the eldest child, slept, and early in the morning rose to watch the birds. It was their universal custom to hill the corn, often from one to two feet high, for its support, and spots are often seen at the present day which were evidently cultivated by them. The colonists very generally imitated this custom, and it has been continued down to our own times in many parts of the country. The men planted and cured their tobacco, which was, ordinarily, the only plant they worked upon, the women managing all the rest.

This brief sketch of the farming of the Indians would not be complete without an allusion to their mode of storing grain for their winter supply. Large holes were dug in the earth, and the sides carefully lined with bark; this was also the work of the women. The corn and the beans, after being dried in the sun, or on rocks or flakes over a fire, were thrown into these holes, and then they were covered up level with the surface of the ground. They were thus preserved, if necessary, through the winter. These excavated barns were carefully concealed by the women from their lazy husbands and sons, lest they should discover and eat up their contents; yet, with all the care they could take, the hogs of the colonists often unhinged their barn-doors, and helped themselves to the golden treasure. History says that one of these Indian barns was discovered by the pilgrims at Truro, at a time when their store of provisions was so reduced as to contain but five kernels of corn to each individual.

They sometimes made additional provision for winter by means of large boxes of wicker-work, or bags or sacks of hemp, which were filled and kept in the wigwam for the more immediate wants of the family. They had, of course, little or no occasion to cut grass, though it grew in abundance along the marshes and the rivers, and in places which had been cleared for cultivation. It was of a coarse quality, and served the colo-

LIFE IN NEW ENGLAND, 1770.

nists a good turn till they resorted to the cultivation of better.

We may imagine the surprise of the natives at the first sight of a plough. They could not understand so complicated a machine. They wanted to see it work; and when it tore up more ground in a day than they, with their clam-shells, could scrape up in a month, and they saw the colter and the share to be of iron, they told the ploughman if he was not the devil himself, he was very much like him.

The first sight of a ship, it is recorded, had excited their wonder even to a greater extent. To them it was a floating island; its masts were nothing but trees; its sails were clouds; its discharge of guns was thunder and lightning; but as soon as the thunder and lightning ceased, they pushed off their canoes to go and pick strawberries on the island!

This cursory glance at the early surroundings of the settlers of the country, will enable us the better to comprehend the difficulties in the way of making rapid progress. When poor and miserable cattle, poor and miserable implements, poor and miserable ideas of farming were the best of every thing they had, we can well imagine that little was done which was not forced upon them by the pressure of necessity. Their wants were too many, and required too vigorous exertions to provide what was indispensable, to admit of their spending time to experiment or seek out new principles to be applied to practical farming. As long as new lands could be had almost for the asking, it was not to be expected that they would till them very thoroughly. The soil was rich in mould—the accumulation of ages—and did not require very careful cultivation to secure an abundant return. But years of constant cropping exhausted its productiveness, when other lands were taken to subject to the same process. The farmer raised wheat year after year on the same land, till the soil became too poor, and then he planted corn; and when it would no longer grow corn, he sowed barley, or rye, and so on to beans.

Agriculture, so far as any real improvement was concerned, was, therefore, naturally enough, in a state of extreme depression for more than a century and a half after the establishment of colonies in various parts of the country. There were few intelligent cultivators previous to the Revolution, and there was no spirit of inquiry to give a charm to farm labor. It was performed as an evil which must be endured from stern necessity. Hard work was the order of the day. The forests were to be cleared, the buildings for shelter erected, the stone walls to be laid, and little time or inclination was left for the "humanities" of life.

The inhabitants of country towns, a hundred years ago, most of whom were, of course, engaged in tilling the soil, seldom visited even their neighboring towns, and many a farmer and farmer's son did not leave his own township from one year's end to another. The liberalizing influence of social intercourse was unknown and unappreciated, unless the village tavern and the frequent glass might be considered as forming an exception, while it afforded an opportunity, of which most men availed themselves, of forming new acquaintances and talking over the stale gossip of the neighborhood, or indulging in the ribald jest.

People for some miles around turned out to a "raising," as the erection of a frame building was termed, and a merry time it was, where the flip and the cider flowed like water. On a more limited scale, the "huskings" brought together, also, a pretty large neighborhood, when the same favorite drinks did much to enliven a long autumn evening, the whole being followed by a sumptuous repast of pumpkin pies, etc., continued into the small hours of the night. Then the "spinning bees" afforded a time for talk, and song, and riddle. Election day often, however, brought the people from a greater distance.

No butcher drove up to the farmer's door, with his ever fresh supply of meats, to give variety to the daily and homely fare; no baker, with his jingling bells, travelled his rounds on stated days to relieve the monotony of the housewife's toil. Salted meats were the almost universal food from autumn till spring, and often from spring till autumn, though now and then a sheep or a lamb fell a victim to the necessity for change. No cottons, no calicoes, no ginghams, no linens, no flannels loaded the counters of the village store, to be had at a sixpence, or a ninepence, or a quarter a yard. The farmer, and the farmer's family, wore homespun, and the spinning-wheel and the huge timber loom were a part of nearly every household furniture, and their noise was rarely silenced. If linens were wanted, the flax was sown, and weeded, and pulled, and rotted, and broken, and swingled—for all of which processes nearly a year was required before the fibre was ready for spinning, and bleaching on the grass, and making and wearing. If woollens, the sheep were sheared, and the wool dyed and got in readiness, and months were often required before it could be got into shape for wearing. Courtships were, therefore, of longer duration than many of them now-a-days, and two years was about as soon as the betrothed farmer's daughter could get ready to go to keeping house. Not unfrequently the flax had to be sown as the preliminary step, and to pass through all its forms of transition into cloth and garments. With our present facilities for manufacturing by machinery every conceivable variety of fabric, and that, too, in the shortest space of time, it is impossible to appreciate fully the state of things among all classes of society a century ago. Even the old processes of curing and preparing flax, and the variety of fabrics made from it, have undergone an entire change. Processes which then required many months to complete, are now wholly avoided by the more perfect and economical ones at present known and in constant use.

Owing to the imperfect provision for schools for the great body of the people, the boy was trained up to a narrow routine of labor, as his fathers had been for a century before. He often affected to despise all intelligent cultivation of the soil, and not only scrupulously followed the beaten track, but was intolerant of all innovation, simply because it was innovation. Very few of the rural population of that day saw a newspaper or a journal of any kind. There were not, probably, a dozen published in the whole country a century ago. There was not one in New England at the beginning of the last century, and but four in 1750, and these had an extremely small circulation beyond the limits of the metropolis.

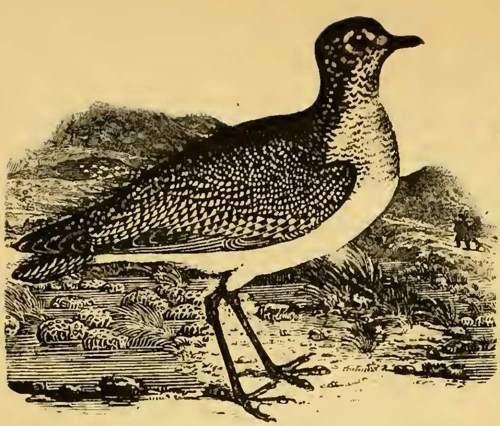
Obstinate adherence to prejudice of any kind is now generally regarded as a mark of ignorance or stupidity. A century ago, the reverse was the case. In many a small country town a greater degree of intelligence—except on the part of the parson and the doctor—than was possessed by his neighbors, brought down upon the possessor the ridicule of the whole community. If he ventured to make experiments, to strike out new paths of practice and adopt new modes of culture; or if he did not plant just as many acres of corn as his fathers did, and that, too, in "the old of the moon;" if he did not sow just as much rye to the acre, use the same number of oxen to plough, and get in his crops on the same day; or if he did not hoe as many times as his father and his grandfather did—if, in fine, he did not wear the same kind of homespun dress and adopt the same religious views and prejudices, he was shunned in company by the old and young, and looked upon as a visionary. He knew nothing of a rotation of crops. The use and value of manures were little regarded. Even so late as within the memory of men still living, the barn was sometimes removed to get it out of the way of heaps of manure by which it was surrounded, because the owner would not go to the expense of removing these accumulations and put them upon his fields. The swine were generally allowed to run at large; the cattle were seldom or never housed at night during the summer and fall months; the potato patch often came up to the very door, and the litter of the yard seldom left much to admire in the general appearance of things about the barn or the house. Farmers thought it necessary to let their cattle run at large very late in the fall, and to stand exposed to the severest colds of a winter's day, "to toughen." It was the common opinion in the Virginia colony, that housing and milking cows in the winter would kill them. Orchards had been planted in many parts of the country, but the fruit was, as a general thing, of an inferior quality, and used chiefly for the purpose of making cider.

This is no picture drawn from the imagination. It is strictly and literally true of the farming of the country as a whole, a century ago, though it should be remarked that a slightly modified state of things existed in localities widely distant. But with some differences in detail, it will be found to be consonant with historical facts.

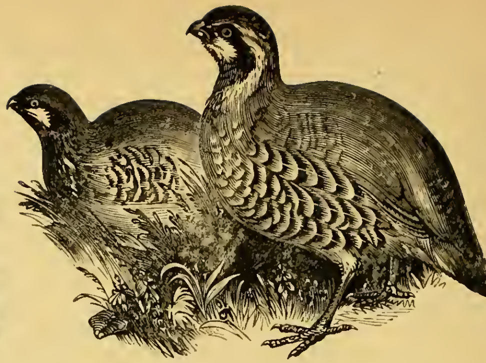
It would be extremely interesting, were it in our power, to support, by accurate statistics, this general view of the condition of farming during the last century, but, unfortunately, no reliable statistics were taken till the year 1790, and then, chiefly to ascertain the number of the population, with special reference to the distribution of the representation, or the political power of the several states. We are, therefore, wholly destitute of statistical information of the products of farming industry during the last century;

GAME OF THE EARLY SETTLERS AND FRONTIERSMEN.

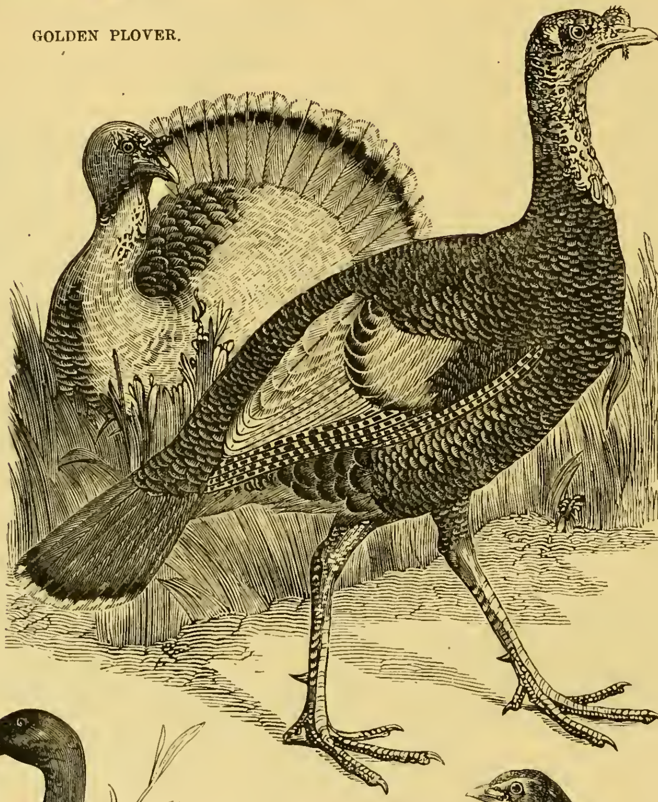
DEER.



GOLDEN PLOVER.



PARTRIDGES.



WILD TURKEY.

CANVAS-BACK DUCK.

QUAIL.

nor was it till the fourth decennial census, in 1820, that the population was divided according to industrial pursuits, so that we have no means of ascertaining even the number engaged in the occupation of farming. We only know that the general estimate of the population at the time of the Revolution, which fixed it at three millions, was considerably too high.

The occurrence of the Revolution, and the period immediately succeeding, very naturally brought men of all pursuits and from all parts of the country more frequently and closely together, and gave all classes, and farmers among the rest, a more general knowledge of what was passing in the world around them. Intercommunication became more easy and frequent, and had its influence upon the masses of the people. In the latter part of the last century many left the seaboard and removed to the interior to avoid the inconvenience arising from the difficulties between this and the mother country, and for other reasons; more attention began to be paid to agriculture. Emigration from the east began to set toward the so-called inexhaustible west, which at that time meant central or western New York.

Up to this point our survey of the condition of agriculture has necessarily been general. No one branch of farming had made any marked and perceptible progress. It has been said that a good strong man could have carried all the implements in use on the farm, except the cart and old clumsy harrow, upon his shoulders, fifty years ago, and we know that many a year occurred when grain, and even hay, had to be imported from England to keep the people and the cattle from starvation. Hereafter, it will be more convenient to trace the progress of the different branches of farm industry, and the means brought to bear in the development and improvement of agriculture, in a more distinct and separate manner, in order that we may get a clearer idea of the relative progress and influence of each. And first, of the origin and growth of

### ASSOCIATED AND LEGISLATIVE EFFORT.

One of the characteristic features of the farming of the present day, is the extent to which associated effort is brought to bear upon all its details, by way of exhibitions, premiums, clubs for discussion, and the publication of reports for wide and gratuitous distribution. This enormous power of mind upon mind, by means of association or social intercourse, is of comparatively recent origin in this country. It can scarcely date back to the beginning of the present century, though the necessity of it had, even then, become impressed upon the minds of patriotic and public-spirited men.

On the 20th of July, 1794, Washington, then president of the United States, addressed a letter to Sir John Sinclair, in which he says: "It will be some time, I fear, before an agricultural society, with congressional aid, will be established in this country. We must walk, as other countries have, before we can run; smaller societies must prepare the way for greater; but, with the lights before us, I hope we shall not be so slow in maturation as older nations have been. An attempt, as you will perceive by the enclosed outlines of a plan, is making to establish a state society in Pennsylvania for agricultural improvements. If it succeeds, it will be a step in the ladder; at present, it is too much in embryo to decide upon the result." And again, in his annual address on the 7th December, 1796, when he met for the last time the two houses of Congress, he said: "It will not be doubted that, with reference to either individual or national welfare, agriculture is of primary importance. In proportion as nations advance in population, and other circumstances of maturity, this truth becomes more apparent, and renders the cultivation of the soil more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater propriety? Among the means which have been employed to this end, none have been attended with greater success than the establishment of boards, composed of proper characters, charged with collecting and diffusing information, and enabled, by premiums and small pecuniary aids, to encourage and assist a spirit of discovery and improvement.

"This species of establishment contributes doubly to the increase of improvement, by stimulating to enterprise and experiment, and by drawing to a common centre the results, everywhere, of individual skill and observation, and spreading them thence over the whole nation. Experience, accordingly, has shown that they are very cheap instruments of immense national benefit."

Some few individuals, even before this date, had felt the necessity for some such action as would lead to the development of the agricultural resources of the country, and as the result, the South Carolina Agricultural Society had been established in 1784, and still exists. The Philadelphia Society for the Improvement of Agriculture was formed in the same year, or the year after, followed by a similar association in New York in 1791, which was incorporated in 1793. The Massachusetts Society for Promoting Agriculture was incorporated in 1792, and soon after commenced the publication of a series of papers known as the *Agricultural Repository*, which, for sound good sense and judicious suggestion, challenges comparison with any similar series ever published. It should be stated, however, that the prime movers in the formation of these societies were not men actually engaged in farming, though many of them were owners of fine estates. The mass of farmers were not, as yet, fully prepared for this progressive effort, and all the agricultural teachings of educated and scientific men prove unavailing, unless the people themselves, the actual tillers of the soil, are prepared to receive and profit by their teachings. Many years elapsed after these early efforts were made, before the habit of reading became sufficiently common among the masses of practical farmers to justify the expectation that any general benefit would arise from the annual publication of the transactions of these societies.

There was little or no disposition in the community to examine the subject, and they failed to excite any spirit of emulation in the public mind. The improvements proposed fell almost dead upon the people, who rejected "book farming" as impertinent and useless, and knew as little of the chemistry of agriculture as of the problems of astronomy. A quarter of a century, however, effected some change, and in 1816 the Massachusetts society held its first exhibition, at Brighton, at which a list of premiums was offered, and a ploughing match instituted, not so much with the object of improving the plough as to try the strength and docility of the oxen. But the plough-maker happened to be there, and to have his eyes open; and since that day, an amount of knowledge has been brought to bear upon this implement sufficient to bring it very near perfection.

The first national society established with this specific object in view, is believed to have been the Columbian Agricultural Society for the Promotion of Rural and Domestic Economy, organized at a convention held in Georgetown, D. C., on the 28th November, 1809; and the first agricultural exhibition in this country was, probably, one held by that society in Georgetown, on the 10th of May, 1810, when large premiums were offered for the encouragement of sheep raising, etc. In the October following, in the same year, Elkanah Watson exhibited three merino sheep under the great elm tree in Pittsfield, Mass., which was the germ of the Berkshire County Agricultural Society, whose regular exhibitions began the year following, and are believed to have been the first county exhibitions ever instituted in this country. To show the feeling with regard to what was, at that time, considered an innovation, in a strictly farming community, the projector of that society encountered the opposition and ridicule of all classes of society, from the moment the proposition was made. It was viewed by many with contempt. Gradually, however, the feelings of the people were enlisted in its favor, premiums were offered and awarded, and a large concourse, from all parts of the county, increasing rapidly from year to year, showed clearly that something had reached the heart of the community.

But though this was the first county exhibition, so far as I am informed, it was not the first county society that was formed. The Kennebec Agricultural Society was instituted at Augusta in 1800 and incorporated in 1801, being the second society incorporated within the limits of Massachusetts, to which Maine, at that time, belonged. A voluntary association of the Middlesex husbandmen had also been formed in 1794, and incorporated in 1803, under the name of the Western Society of Middlesex Husbandmen.

These were some of the early efforts in this direction, and though they, like other similar attempts, met with some opposition on the part of the very class they were intended to benefit, the increasing intelligence of the people very soon enabled them to live it down. Now we have more than a thousand similar associations, all striving, by the offer of premiums, and by bringing together the best products of the farm and the garden, to encourage improvement and stimulate enterprise. Almost every state in the Union has its state society, and almost every county, and, in some of the states, every county, has its county organization. And what is the result? It is well known that by far the largest and most valuable part of our practical knowledge is that which is got in our intercourse with our fellow men, with those who are engaged in the same pursuits and have the same interests as ourselves. The farmer has, therefore, gained, and is gaining a vast amount of information, much of which he can apply to advantage on his farm. Emerging from his naturally isolated position, he has become a more social being. More frequent contact with others, by way of competition, has stimulated mental activity. Contrast him now with his father on the same farm half a century ago, and see if there is not some improvement that can be traced to the social influences of the agricultural clubs and societies.

In addition to these societies, most, if not all of which are encouraged by the several states in a substantial manner, there exist, in some of the states, boards of agriculture, organized as departments of the state government, and having a general supervision of the societies, receiving their official returns, and publishing an abstract of the most valuable papers presented, for general distribution.

I do not think it is claiming too much for the agricultural societies throughout the country, to say that the general spirit of inquiry in relation to farm improvements, and much of the enterprise manifested by farmers of the present day, is due to their efforts. The most impartial judgment would, in fact, go much further than this, and say that a large proportion of the actual improvement that has been made in farm stock, farm implements, and farm products, may be traced, directly or indirectly, to the influence of the agricultural associations of the country.

To appreciate this influence it is only necessary to consider the immense facilities which a well-conducted exhibition gives, not only to the agricultural mechanic for making known the nature and value of his improvements, but to the farmer for becoming acquainted with them. Many an invention would have slumbered in oblivion, or enjoyed only a limited and local fame, had it not been for the multitudes brought together at the state, county, and town fairs, which, it will thus be seen, furnish a most admirable medium of communication, both to the mechanic and the farmer, making it for the interest of both to attend and avail themselves of the facilities offered them. Thus a great public interest is served, notwithstanding the individual mechanic or inventor may have his own interest chiefly at heart.

And what is true with regard to agricultural implements, is true to nearly an equal extent of every thing else brought for exhibition to the fairs of the societies. A farmer sees fruits that he knew nothing of, and could not obtain otherwise. He knows who presented them, secures the same for his own farm, and within five years can present as good samples himself. He sees animals brought to a degree of perfection of which he had never, perhaps, conceived. Thought is excited. He asks himself whether they are more profitable than his own; procures them, perhaps, and thus an improved stock is disseminated over the country to take the place of that which is inferior, but which costs the individual nearly or quite as much to keep as that more valuable and profitable.

I need not enlarge upon this point. Enough has been said, I think, to show that the modern system of associated effort is a most decided progressive movement; but let us trace out more in detail some of its results. And first, in the multiplication and improvement of

### FARM IMPLEMENTS.

There is, perhaps, no branch of farm economy in which the progress of improvement has been so apparent and unquestionable, as that made in the implements of agriculture during the last half century. It might almost be said that progress in agriculture itself may be measured by an increased demand for new and better implements, as the advance in civilization is shown by a greater demand for comforts and luxuries by the people.

There was a time, as we have seen, in the history of American farming, when labor was cheap, when strong limbs and the power of endurance were the requisites chiefly sought for in the hired man, and when his labor was paid for as so much brute, physical force. Intelligent labor, skill, and thought found higher rewards in other callings, and the practical farmer was thought to be sufficiently well informed if he was able to hold plough, to mow, to sow, and to reap. The labor—the physical force necessary to carry on the operations of the farm—could be obtained very easily in those days, and it was natural that farmers should be satisfied with the limited variety of implements then in use. The isolated position in which they were placed, their limited opportunities for travel and observation, the difficulties, in fact, of getting about among people engaged in the same pursuits, all helped to strengthen prejudice and foster a repugnance to try new and unused implements, or to strike out into new fields of experiments. Besides these obstacles in the way of improvement, the progress then made in the various branches of mechanics was extremely limited, and the adoption of new and improved implements must follow, of course, in the wake of mechanical invention. The few rude and imperfect implements in use at an early day were, for the most part, of home manufacture, or made by the neighboring blacksmith, who had a thousand other things to make at the same time. There was little idea of a division of labor. Jack at all trades was good at none.

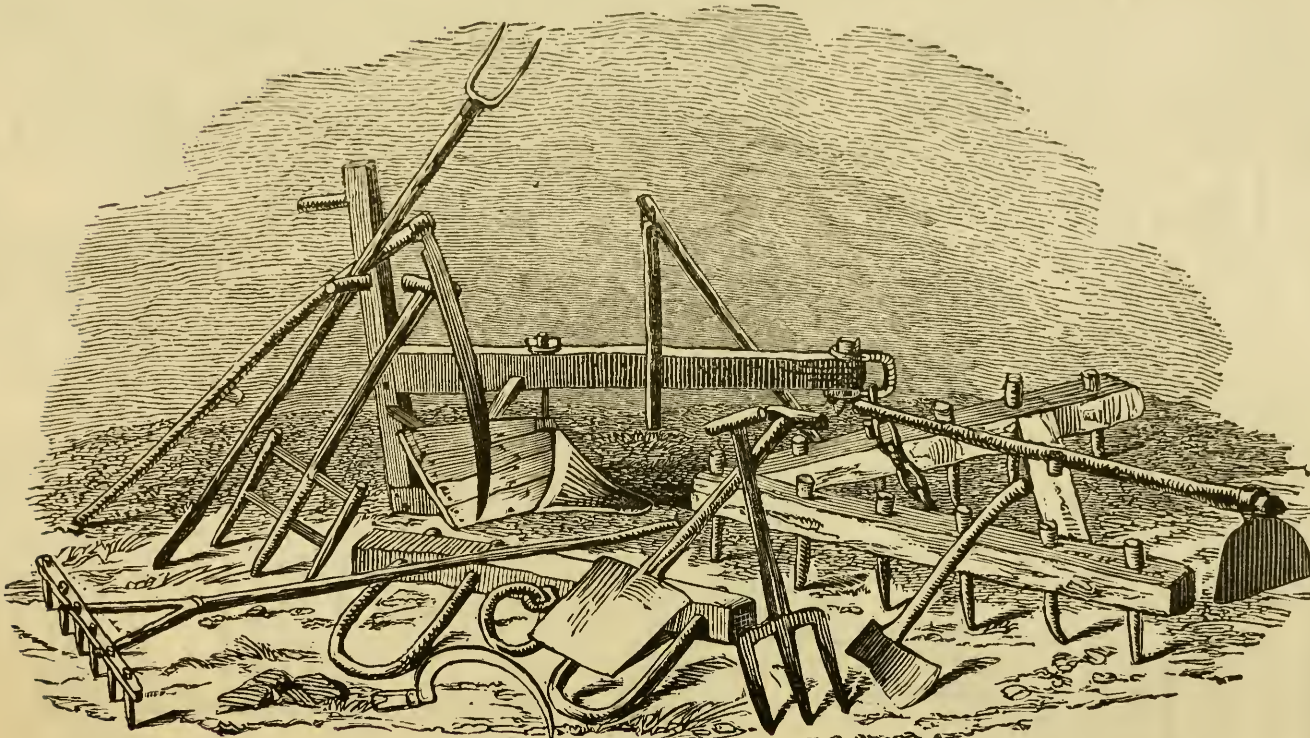
As early as 1617, some ploughs were set to work in the Virginia plantation, but in that year the governor complained to the company that the colony "did suffer for want of skilful husbandmen, and means to set their ploughs on work; having as good ground as any man can desire, and about forty bulls and oxen, but they wanted men to bring them to labor, and iron for the ploughs, and harness for the cattle. Some thirty or forty acres we had sown with one *plough*, but it stood so long on the ground before it was reaped, it was most shaken, and the rest spoiled with the cattle and rats in the barn." This complaint had some effect, for, in 1648, a cotemporary resident says: "We have now going near upon a hundred and fifty ploughs," and they were drawn by oxen.

It is recorded that in 1637 there were but thirty-seven ploughs in the colony of Massachusetts Bay. Twelve years after the landing of the pilgrims, the farmers about Boston had no ploughs, and were compelled to break up the bushes and prepare for cultivation with their hands, and with rude and clumsy hoes or mattocks. It was the custom, in that part of the country, even to a much later period, for any one owning a plough to go about and do the ploughing for the inhabitants over a considerable extent of territory. A town often paid a bounty to any one who would buy and keep a plough in repair for the purpose of going about to work in this way. The massive old wooden plough required a strong and well-fed team to move it through the soil, a heavy, muscular man to press it into the ground, another to hold, and another to drive. We may judge, therefore, of the economy of the work it performed. What was true of the early period of the settlement, was true, to nearly an equal extent, for a hundred and fifty years, so far as the implements and the processes of farming are concerned. All these last were traditional, handed down from sire to son, and adhered to in the strictest manner. The implements consisted almost wholly of the plough, the spade, a clumsy wooden fork, and now and then a harrow. I have in my possession two of these wooden forks, made, and in use, at least a hundred and fifty years ago, in the Massachusetts colony. They were regarded as curious for their antiquity in the youth of the grandfather of the donor, who died some years ago, upward of ninety years of age. That would date them back nearly two centuries, perhaps.

At this time, the ploughs used among the French settlers in Illinois were made of wood, with a small point of iron tied upon the wood with straps of raw-hide. The beams rested on an axle and small wooden wheels, the whole drawn by oxen yoked to the ploughs by the horns, by means of a straight yoke attached by raw leather straps, with a pole extended from the yoke back to the axle. The plough was very large and clumsy, and no small one was used by them to plough among the corn till after the war of 1812. The carts they used had not a particle of iron about them.

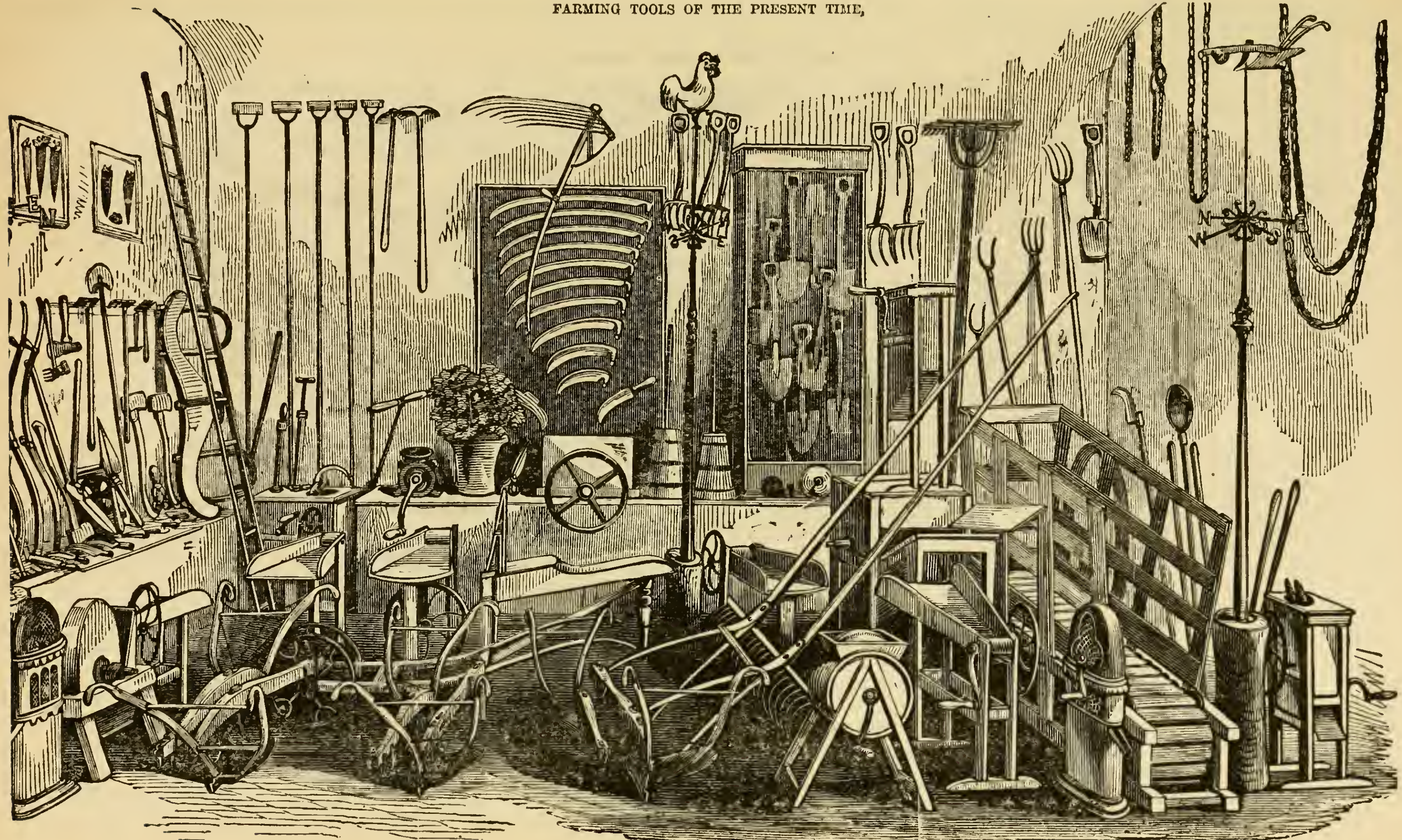
During the last century, the old "Carey plough" was more extensively used in the Atlantic states than any other pattern, though the particular form of this instrument varied almost as much as the number of small manufacturers or blacksmiths who made it. The Carey plough had a clumsy wrought iron share, a land-side and standard made of wood, a wooden mould-board, often plated over, in a rough manner, with pieces of old saw-plates, tin, or sheet iron. The handles were upright, and were held by two pins; a powerful man was required to hold it, and double the strength of team now commonly used in doing the same kind of work.

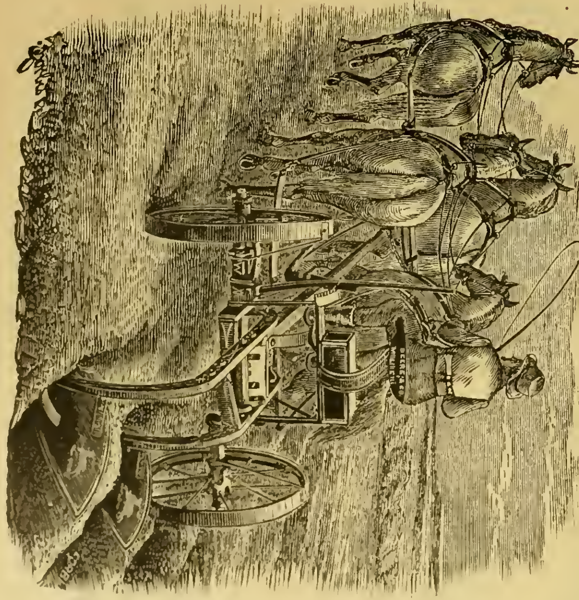
The "bar-side plough," or the "bull plough," was also used to some extent. A flat bar formed the land-side, and a big

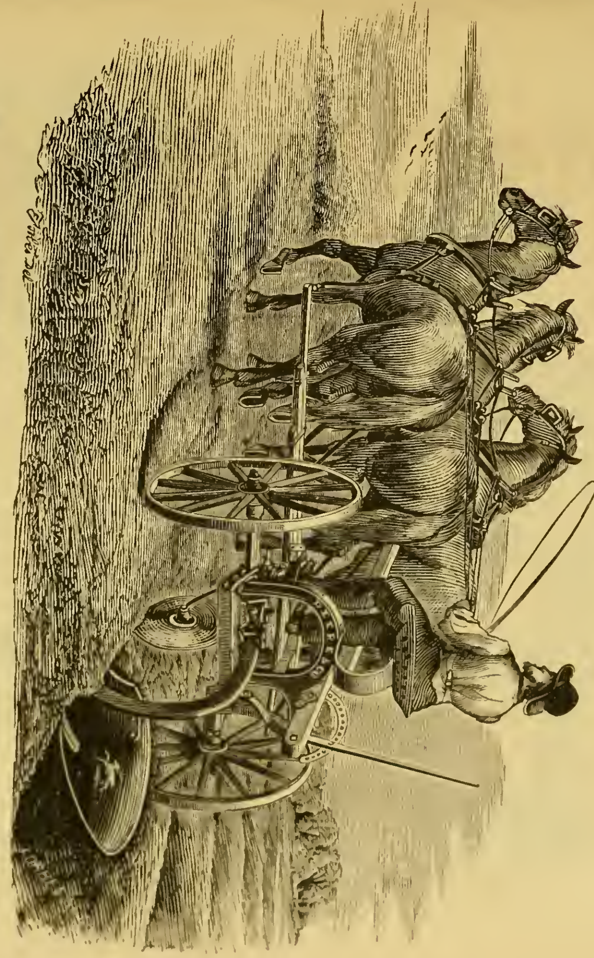


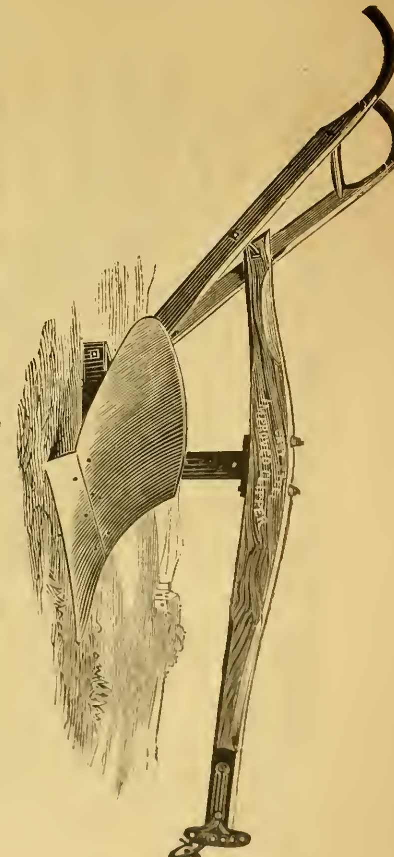
FARMING TOOLS IN USE IN 1790.

FARMING TOOLS OF THE PRESENT TIME,



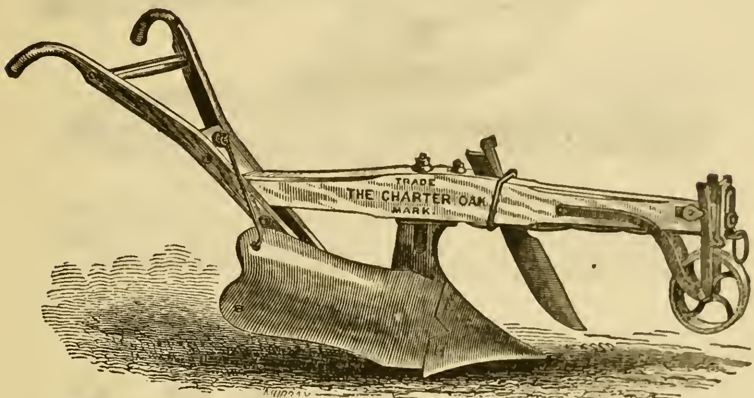






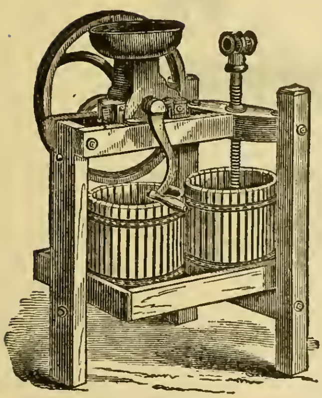
1.—HIGHLANDER PLOW.
2.—THE KING OF SULKY PLOWS.
3.—THE DEERE GANG PLOW.
DEERE & COMPANY., MOLINE, ILL.

## HIGGANUM MANUFACTURING COMPANY, HIGGANUM, CONN.




CHARTER OAK SWIVEL PLOW. SANBORN'S LAST PATENT.

The only Perfect Swivel Plow manufactured. A Reversible Plow, adapted to general work.

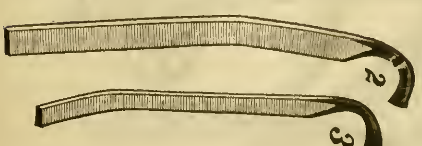


CIDER AND WINE MILL.

HOLBROOK'S

"VETO" SEED DRILL.

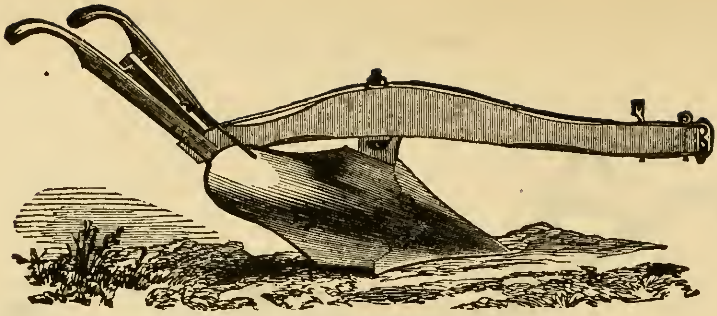
For Sowing Beet, Carrot, Onion, Turnip, Parsnip, Spinach, Fodder Corn, Peas, Beans, &c.




PLOW HANDLES.

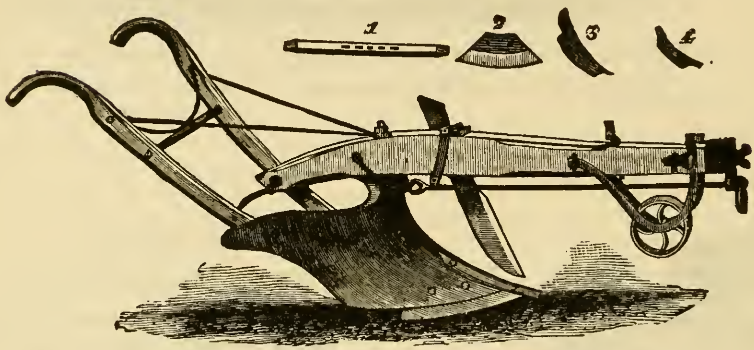
WELLS' SEED SOWER.

For grain or grass seed.



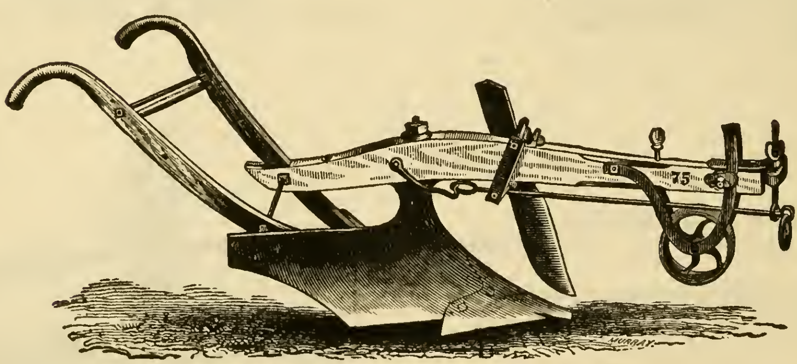
## COMMON SIDE HILL OR SWIVEL PLOW.

Of the above Plow we manufacture nine different sizes—two with iron beams, and seven with wood beams. They are constructed so that the mold board is easily changed from one side to the other, which enables the operator to perform the work horizontally upon side hills, going back and forth on the same side.




## EAGLE SELF-SHARPENER.

Fig. 1 of the above cut represents the point. As it wears, it is easily moved forward and turned the other side up, thus always presenting a sharp point of full length and proper shape. Fig. 2 is the wing or share, and is reversible, being used either end or side up. Fig. 3 represents the cast iron colter a little back and above the point. Fig. 4 represents the cap that protects the shin or forward part of the mold. Four Sizes.




## DEEP TILLER PLOW.

This cut represents one of the series of the Deep Tiller or Green-sward Plows of the line of the celebrated J. Nourse Plows. Four Sizes.

clump of iron, shaped a little like the half of a lance head, served as a point, into the upper part of which a kind of colter was fastened. The mould-board was wooden, and fitted to the irons in the most bungling manner. The action might be illustrated by holding a sharp-pointed shovel back up, and thrusting it through the ground.

In the southern states, the "shovel plough" was in general use down to a very recent date, and is, indeed, to some extent, at the present day. It was made of a rough-hewn stick for a beam, with another stick framed in, upon the end of which a piece of iron, shaped somewhat like a shovel, sharp-pointed, was fastened. The two rough handles were nailed or pinned on to the sides of the beam, having a wooden prop, with a draft iron, or a raw-hide loop, at the forward end of the beam

Generally speaking, it might be said that the ploughs used in this country a century ago, were not very unlike those used by the old Romans before the Christian era, and by some of the people of southern Europe even at the present day. They were not unfrequently nor inaptly termed the "hog plough," on account, probably, of their propensity to root into and out of the ground. And in describing the plough, an adequate idea of all other kinds of farm implements—the variety, as we have seen, being extremely small—is clearly enough conveyed. These old-fashioned wooden ploughs continued, with little or no improvement, till after the beginning of the present century.

By far the greater part of the draught of the plough, or strength of team required, is due to friction in the soil. The cutting, raising, and turning over of the turf add comparatively little to the draught, though, it is true, the friction itself is somewhat increased by the weight of the plough, and this weight is, of course, increased by the weight of the furrow-slice as it is lifted from its bed. Hence, the draught of the plough is but slightly increased by an increase of speed, since the friction is not increased, but remains nearly the same on the bottom of the furrow, on the land-side, and between the furrow-slice and the mould-board, whether the motion be fast or slow. Modern improvements have aimed, therefore, to overcome the friction and resistance by an improved construction of the mould-board and by the use of better materials, for it is now well established, by practical experiment, that the draught depends less on the weight of the plough itself, than on its construction. The draught does not increase in proportion to an increase of weight, and hence, though some still object to the modern plough, as compared with the models in use fifty years ago, on account of their being heavier, yet it is a common remark that the draught is easier, and they require much less strength of team to do the same, or a far better work.

The excessive friction of the old-fashioned bull plough was the great objection to it. It was constructed awkwardly enough, in the first place, but the form of the mould-board was especially defective, and this it was that required such great strength of team. It did pretty fair work, no doubt, on light and easy soils, but the share and the mould-board were so attached, as to make the wedge too blunt, which, of course, made the friction excessive. It broke and crumbled the furrow-slice, in places, and was not calculated to turn a flat furrow. But the action of the old plough was not uniform, some furrows being set too much on the edge, while others were laid quite flat. It was not its weight so much as its form that needed improvement. Its construction not being based on such principles as to make it of easy draught, it was more difficult to hold, more easily thrown out of the ground, and required constant watchfulness on the part of the ploughman. It was difficult to cultivate to any depth without the help of one or two men to ride on the beam to "hold down." The mould-board was frequently shod with iron, as we have seen, to diminish the friction and prevent wear; but it was in strips, and uneven, and the desired effect was not always produced.

It is not too much to say that the changes and modifications made in the mould-board within the last fifty years, have effected such improvements as to enable the farmer to do a much greater amount of better work, with far less expenditure of strength, and to reap larger crops as the result, while the original cost of the implement is less than it formerly was. The saving to the country from these improvements alone, within the last thirty-five years, has been estimated at no less than $10,000,000 a year in the work of teams, and $1,000,000 in the cost of ploughs, while the aggregate of the crops has been increased by many millions of bushels.

These improvements in the form of the

mould-board will be understood, when we consider that one side of the furrow-slice, as soon as it is cut, begins to rise gradually, till, as the plough advances, it is turned entirely over. The mould-board should be so constructed as to offer the least possible resistance as it moves along, and to run as far as possible without clogging, to which the old plough was especially liable, the lines of its mould-board being concave, instead of convex or straight, according to the rules more recently laid down requiring the "board to be composed of straight lines in the direction of its length, with continually increasing angles to the line of the furrow; and these last lines are severally straight, convex, and concave." Ransome, after the most mature study of this implement, says: "Although no one form of mould-board will, or can be applicable to every variety of soil and circumstance, there is no description of soil for which a perfect mould-board may not be made by this rule in some of its modifications."

Such was the condition of things with regard to this, and most other farm implements, at the close of the last and beginning of the present century, or till within the last forty or fifty years.

The first patent for a cast iron plough in this country, is believed to have been that of Charles Newbold, of Burlington, N. J., in 1797. This patent combined the mould-board, share, and land-side, all cast together. It was so great and manifest an improvement on the old wooden plough, that Peacock, in his patent of 1807, paid the original inventor of the plough of 1797 the sum of $500 for the privilege of copying some parts of it.

A cast iron mould-board had been invented in Scotland, it is proper to remark, as early as 1740, by James Small, but he still continued to use the wrought iron share, cast iron not being used in its construction till 1785. Small established a plough manufactory in 1763, and becoming familiar with the manufacture of cast iron, not long afterward, he conceived the idea of making patterns of the principal parts of the plough. But whether the American inventor had a knowledge of the existence of these ploughs is not known.

Such was the extreme importance of this implement, as to command the attention of scientific men in studying to improve its form and construction, and, in 1798, Thomas Jefferson applied himself to the task, and wrote a treatise on the form of the mould-board, discussing it on scientific principles, calculating mathematically its exact form and size, and especially its curvature, with a view to lessen its friction. I have seen his original manuscript of this essay, containing his drawings, etc., now in the possession of a gentleman of Boston. Since his time, such an amount of scientific and practical skill has been brought to bear upon this implement, as to leave little to suggest. But it should be stated that the successive improvements were not readily adopted by the mass of farmers. Their introduction was far slower than that of an improved implement would be at the present time, though the prejudice against the use of new inventions has not yet wholly disappeared. Many a farmer, clinging to the old wooden plough, asserted that cast iron poisoned the ground, and spoilt the crops. Still, the modern styles gradually gained ground, as real improvements always will. In one respect we have especially improved, and that is the adaptation of our ploughs to the different kinds of soil on which they are to be used. When attention was first directed to the improvement of this implement during the latter part of the last century, the principles of ploughing were not so well understood as at the present day. The work was neither so carefully done nor so critically examined, and, consequently, the want of different forms of the plough adapted to the varieties of surface and of soil was not so much felt as now, when nearly every farmer sees that he cannot produce directly opposite effects with the same implement. In another respect, also, custom has changed as much as the forms of the plough itself, for while a half century ago it was made by the blacksmith in nearly every small town in the country, it is now made in large establishments by those who devote themselves exclusively to the business, and these establishments have gradually diminished in number, while the aggregate number of ploughs has largely increased. In the single state of Massachusetts, for example, there were, in 1845, no less than seventy-three plough manufactories, making annually 61,334 ploughs and other agricultural implements, while in 1855 there were but twenty-two plough manufactories, making 152,686 ploughs, valued at $707,175.86. Up to the year 1875 there had been more than one thousand three hundred patents issued from the Patent

Office at Washington, for changes and improvements on this implement.

I need not dwell upon the wonderful performances of the steam plough, the practical and successful operation of which is one of the proudest triumphs of modern agricultural mechanics and engineering. I need not dwell on the vastly increased facilities it will give for developing the resources of the west, through whose almost boundless prairies it will run unobstructed, like a thing of life.

The harrow naturally follows the plough, and is equally indispensable. It has, probably undergone fewer changes and modifications, if we except those made within the last ten years, than any other of our farm implements, most of the forms of the modern harrow in use bearing a close resemblance to those of the ancients, as illustrated on medals and sculptures. The old harrow, and that used by our fathers till within the memory of men still living, was made of wood, of simple bars and cross-bars furnished with teeth. More recently the material used has been of iron, with teeth commonly pointed with steel, and this has partly obviated the objections made to this implement on account of its great weight, which required too slow a motion on the part of the team.

A light, sharp-toothed harrow, moved quickly over the ground, accomplishes far the best work in preparing the soil for the reception of seed. So important is it that this implement should be rapidly moved, that the work of the same implement, drawn sluggishly over the ground, or moved more rapidly, differs very widely in its results. A certain amount of weight is very important, it is true, and this weight differs according to circumstances; but it is desirable to have it in the most compact form. The recent improvements, by which a complete rotatory motion is secured, together with a certain degree of flexibility gained by pieces of framework hinged together so that any part of the implement can be lifted or moved without disturbing the operation of the rest, seem to leave little to desire in respect to this important farm implement. This is a case, as well as that of the plough, of most decided improvement in an implement of very ancient date, handed down to us, in fact, from remote antiquity.

As specimens of important labor-saving implements of modern invention and construction, we may mention a large class known as horse-hoes, grubbers, cultivators, drills, seed-sowers, and others of like character. The seed-sowers and drills scatter the seed more uniformly than it could possibly be done by hand; dropping also, when it is desired, any concentrated or pulverized manure, and covering the rows. All the implements named, of which there is an infinite variety of forms, are most marked and decided improvements on manual labor, which was required by our forefathers for the same processes.

Another large class of implements, among the most important of modern inventions, are the various kinds of harvesters, particularly the reapers and the mowers.

Many of our grain crops, like wheat, barley, and oats, come to maturity at nearly the same time. Wheat is liable to sprout in moist weather, and barley to become discolored if allowed to stand too long. The work of harvesting by the old method was necessarily slow and protracted. Previous to the introduction of the reaper, very large quantities of our most valuable grain were annually lost, owing to the impossibility of harvesting it properly and at the proper time. It is not, therefore, too much to say, that the successful introduction of the reaper into our grain fields has added many millions of dollars to the value of our annual harvest, not only by enabling us to secure the whole product, but also by making it possible for the farmer to increase the area of his cultivated fields, with a certainty of being able to gather in his whole crop.

The sickle, which was in common use for harvesting the grain crop till the introduction of the cradle, and, in fact, till a very recent date, was undoubtedly as old as Tubal Cain. No one who has had a practical experience of its use, bending over in the most painful position from "early morn till dewy eve," can fail to appreciate the immense saving of human muscle, and of slow and wearisome hand labor, by the introduction and use of the reaper.

It would have been an astonishing evidence of stupidity on the part of the ancients, who relied mainly on wheat and the other smaller grains, had they not tried, at least, to replace the sickle by something better. This they did, for it is recorded that the farmers of Gaul used a simple reaper, not long after the time of Christ. Pliny asserts that the inhabitants of that country fixed a series of knives into the tail-end of a cart, and this being propelled through the grain, clipped off the ears or heads, and thus it was harvested.

Many efforts were made in England and Scotland, at the beginning of the present century, to accomplish the same result, but with no great success. In the year 1833, Schnebley, of Maryland, obtained a patent on a machine for reaping grain; but that of Obed Hussey, of Baltimore, patented in the same year, has not only been successfully and somewhat extensively used from that time to this, in the western states, but has furnished the basis for the most successful models in this country, among the most noted of which are those of McCormick, of Virginia, and Manny & Atkins, of Illinois.

The American reaping machines have been brought to a high state of perfection within the last twenty years. They have already a world-wide reputation. Their superiority is generally acknowledged, and the credit of having for the first time made the principles applicable to such machinery practically useful, undoubtedly belongs to our own ingenious mechanics. In the summer of 1855, the American machines were brought to trial at the exhibition at Paris, in competition with the world.

This trial took place in a field of oats about forty miles from the city, each machine having about one acre to cut. Three machines were entered for the first trial, one American, one English, and a third from Algiers, all at the same time raking as well as cutting. The American machine did its work in twenty-two minutes, the English in sixty-six, and the Algerian in seventy-two. At a subsequent trial on the same piece, when three other machines were entered, of American, English, and French manufacture, respectively, the American machine cut its acre in twenty-two minutes, while the two others failed. The successful competitor on this occasion, "did its work in the most exquisite manner," says a French journal, "not leaving a single stalk ungathered, and it discharged the grain in the most perfect shape, as if placed by hand, for the binders. It finished its piece most gloriously."

The contest was finally narrowed down to three machines, all American. Two machines were afterward converted from reapers into mowers, one making the change in one minute, the other in twenty. Both performed their task to the astonishment and satisfaction of a large concourse of spectators, and the judges themselves could not restrain their enthusiasm, but cried out "Good, good, well done," while the people hurrahed for the American reaper, crying out, "That's the machine, that's the machine!" "All the laurels," says the report of a French agricultural journal, "we are free to confess, have been gloriously won by Americans, and this achievement cannot be looked upon with indifference, as it plainly foreshadows the ultimate destiny of the new world!"

And so with the mowing machines. The hay crop of the country is estimated at three hundred and fifty millions of dollars a year. It must be gathered at a season when labor is to be obtained with difficulty, and at even higher than the usual price of wages, and when the weather is often fickle and precarious, generally oppressively hot, making the task doubly irksome and unhealthy. But besides this, many acres of grass on our ordinary farms ripen at about the same time, which, if allowed to stand too long, will decrease in quantity and value of hay which might otherwise have been made from it. By the use of the mowing machine it can be secured and saved most quickly, easily, and cheaply.

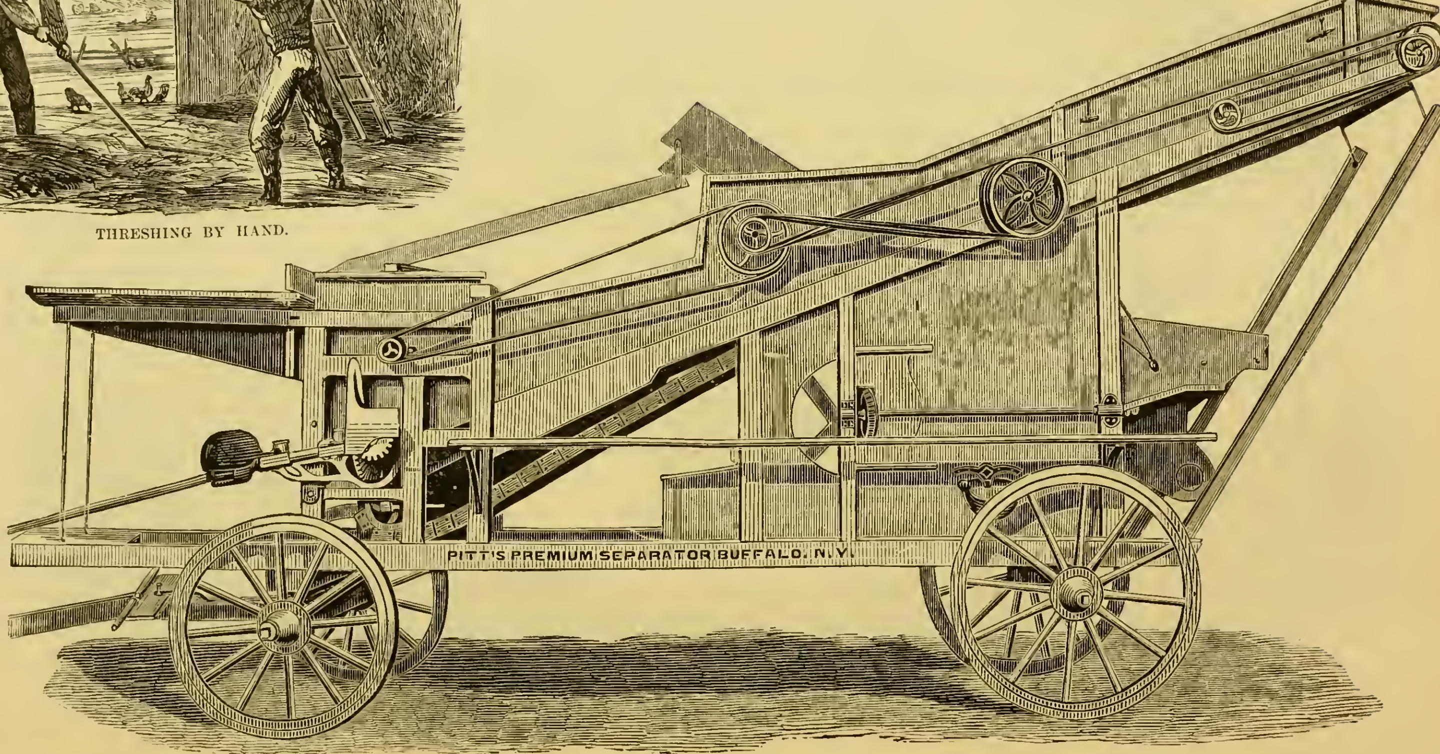
Mowing is, at best, one of the severest of the labors of the farm, notwithstanding the efforts of poets and other writers to make us believe it is all fun. It calls into play nearly every voluntary muscle in the body, requiring not only the more frequent and regular movements of these muscles, but, on account of the twisting motion of the body, an unusually great exertion of muscular power. Nor does it require any small amount of skill to become a good mower, since it is proverbial that, unless the boy becomes accustomed to the scythe, and learns while young, he can never become a skilful mower. It is not at all surprising, therefore, that mechanical ingenuity should have been directed to shorten and lighten this severe operation.

The first mowing machine which met with any success in this country, is believed to have been that of William Manning, of New Jersey, patented in 1831, and which met with a limited success more than twenty years ago. In 1834 appeared the Ambler patent, simple in its construction, with a cutter bar of wrought iron, and a single smooth-edged knife, operated by means of a

HAY-TEDDER.


THRESHING BY HAND.

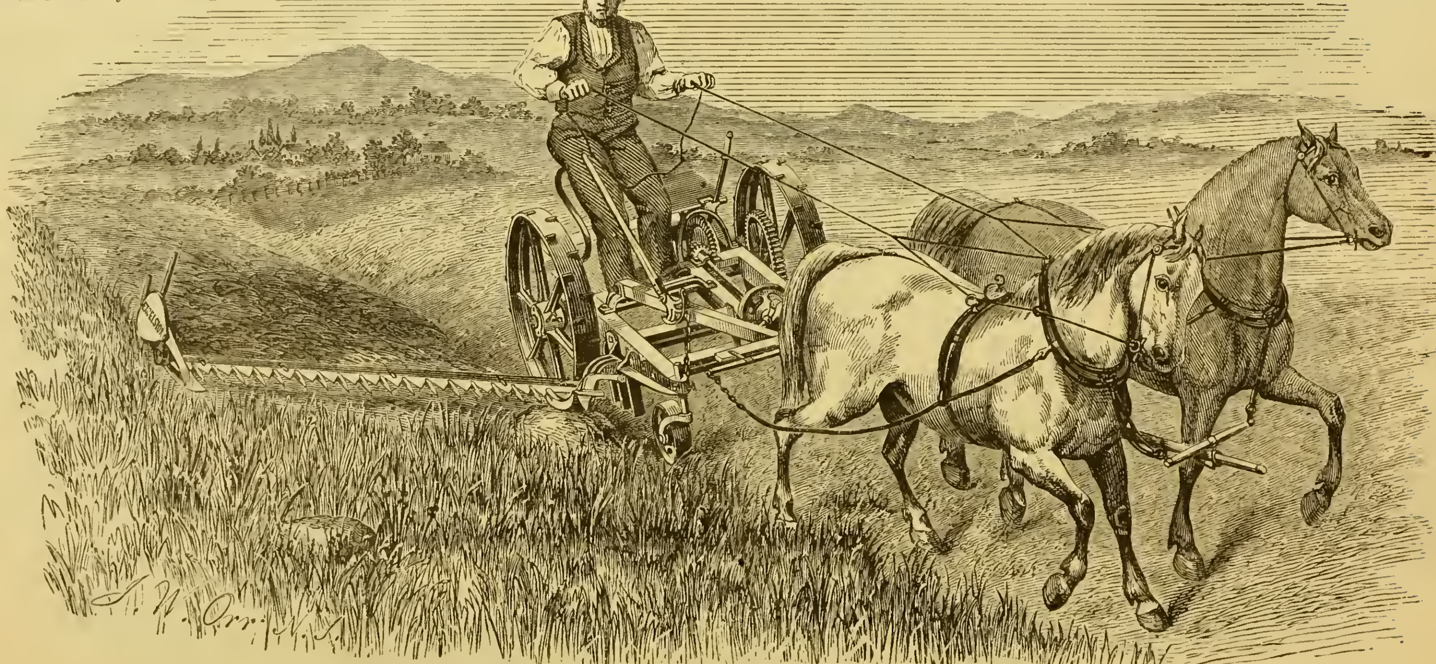
One man gets out from ten to fifteen bushels per day. Machines vary in size from four to twelve horse power. Twelve-horse power and fifteen men get out from six hundred to twelve hundred bushels per day, according to kind and condition of grain.




THRESHING MACHINE, FROM FOUR TO EIGHT HORSE POWER, ACCORDING TO SIZE.

WOOD'S HARVESTER COMBINED WITH LOCKE'S SELF-BINDER. WALTER A. WOOD, HOOSICK FALLS, N. Y.

Old-fashioned way of mowing.




"EXCELSIOR MOWER" WORKING WITH THE CUTTER BAR ELEVATED AND RIGHT WHEEL PASSING THROUGH A DITCH.

crank which gave it a vibratory motion. It was used in 1835 and 1836. A few other efforts were made about that time, and met with some slight success, but it was not till a recent date that the machine was constructed in a manner to give a confident hope of its ultimate and complete success. That hope has been fully realized, and the mower is one of the grandest agricultural inventions of modern times. Like all other inventions, it was adopted by the farmer with his usual caution, but its triumph has been so complete, that its utility and its economy are almost universally admitted, and the number manufactured, and the sales to farmers, have been immense, and are even now rapidly increasing every year. As an evidence of this, McCormick is reported to have sold no less than four thousand of his reapers to the farmers around Chicago, for the single harvest of 1860, and other manufacturers have no doubt met with similar encouragement.

Contrast also the slow process of raking hay by the common hand rake, with the rapid and easy method of gathering it with the horse rake, accomplishing with great ease to a single man who drives, the labor of at least ten men with the old hand rake. With a common revolving rake, from twenty to twenty-five acres a day may be gathered up, and sixteen acres a day have been raked with the simplest form. What a security on the approach of a storm, when the farmer would be comparatively helpless with nothing but the common rake to rely on !

But what shall we say of the modern threshing machine as compared with the flail? Who does not well remember its familiar sound, and that beautiful description of Cowper—

> "Thump after thump resounds the constant flail,
> That seems to swing uncertain, and yet falls
> Full on the destined ear"?

Only think of the difference in the results. At the trial of threshing-machines at the Paris exhibition, the victory was won by an American machine, and during the operation, to ascertain the comparative rapidity of threshing, six men were engaged in threshing with flails, who in one hour threshed sixty litres of wheat. In the same time

| | | | | |
|---|---|---|---|---|
| Pitt's American | machine | threshed | 740 | litres, |
| Clayton's English | " | " | 410 | " |
| Duvoir's French | " | " | 250 | " |
| Pinet's | " | " | 150 | " |

and a French journal, in speaking of the trial, said: "This American machine literally devoured the sheaves of wheat. The eye cannot follow the work which is effected between the entrance of the sheaves and the end of the operation. It is one of the greatest results which it is possible to attain. The impression which this spectacle produced on the Arab chiefs was profound."

At the great fair in New York, in 1853, a machine was exhibited which not only threshed and winnowed the wheat, but measured it, placed it in bags ready for the market, and recorded accurately the number of bushels, and all by one continuous operation.

These vast and acknowledged improvements in harvesting and threshing grain will be seen to be of the utmost importance, when it is considered that we annually raise about two hundred millions of bushels of wheat, and of rye, barley, and oats over one hundred millions, and that the resources of the country may be developed, by the use of machinery, to an extent far beyond the reach of present calculation.

The reaper, the thresher, and the mower are types of the ever restless and progressive spirit of the age. They point out to us a glorious future, in which they will accomplish for us and for our country triumphs grander than the triumphs of arms, for they will develop the means of supporting the millions of human beings which the implements of war can only destroy.

Could the learned Malthus—who proclaimed the gloomy theory that war, famine, and pestilence were checks, designed by an all-wise Being to keep down the increase of population to a level with the means of sustenance—now rise up from his sleep of death and see the population of England more than doubled since his day, and that of this country multiplied many times, while the people are better fed, and better clothed, with less labor and less suffering, with the possibility of a famine wholly and forever removed, he might change his shameful doctrine, and adopt a more cheerful and hopeful view of the providence of God. With an immense multiplication of the human species in all civilized countries which have been devoted to the arts of peace and the development of their material resources, a bountiful Father has sent us a superabundance of food, instead of famine, and has taught us to rely on the exhaustless bounty of the fruitful earth, and upon his beneficent promise that seed time and harvest shall never fail to supply the daily wants of his children.

But with all the progress which we have made in improving the implements of the farm, we have not reached perfection. No bound is set to human ingenuity, and further means may yet be devised to shorten labor and increase the products of the soil.

We cannot hope, nor is it desirable, to avoid labor. This is not the object of improved machinery; but to make labor more attractive, agreeable, and productive; to bring into subjection the rude forces of nature, and make them do our bidding and increase our stores; to redeem thousands of acres now lying waste from wildness and desolation, and to make our country the granary of the world—these are triumphs we may hope to gain from the introduction and use of improved machinery, and in this view the subject commends itself to the attention of the highest intellect, and opens a field for the labors of the noblest philanthropy.

PROGRESS IN THE RAISING OF STOCK.

Allusion has already been made, incidentally, to the character of the cattle from which the early importations into this country must, for the most part, have been drawn.

The first animals that arrived in any part of the present territory of the United States were probably those taken to the colony on the James river, in Virginia, previous to the year 1609, the exact date of their arrival not being known. Several cows are known to have been carried there in 1610, and during the following year, 1611, no less than one hundred head arrived there from abroad.

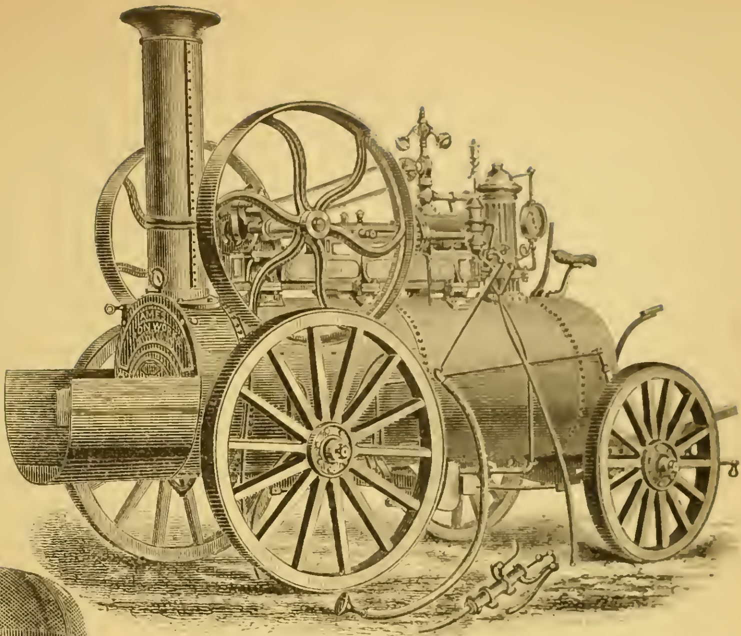
It is probable that those first introduced there were brought over by the earliest adventurers, and others came from the West Indies. It is well known that some of their cattle came from Ireland. Those from the West Indies were the descendants of cattle brought to America by Columbus in his second voyage, in 1493. I have seen it asserted that so important was it considered that the cattle introduced into the infant colony should be preserved and allowed to increase, that an order was issued forbidding the killing of domestic animals of any kind, on pain of death to the principal, burning of the hand and cropping the ears of the accessory, and a sound whipping of twenty-four hours for the concealer of a knowledge of the facts. Such encouragement being given to the raising of stock, it is not surprising to find the number of cattle in Virginia in 1620 amounting to about five hundred head; and in 1639, to thirty thousand; while from the fact that in 1648 the number had been reduced to twenty thousand, we may infer that the restrictions on killing them had been removed. Many also had been sent to New England.

The first cattle that were introduced into the Plymouth colony, and undoubtedly the earliest brought into New England, arrived at Plymouth, in the ship Charity, in 1624. They were imported by Governor Winslow for the colony, and consisted of three heifers and a bull. A division of the stock, which appears to have been held in common, was made in 1627, when one or two are described as black, black and white, others brindle; an evidence that there was no uniformity of color. These animals were to remain in the hands of individuals receiving them for ten years, they to have the produce, while the old stock was still to be owned by the colony in common. Twelve cows were sent to Cape Ann in 1626, and in 1629 thirty more, while in 1630 about a hundred animals were imported for the "governor and company of the Massachusetts Bay in New England." These cattle were kept at Salem.

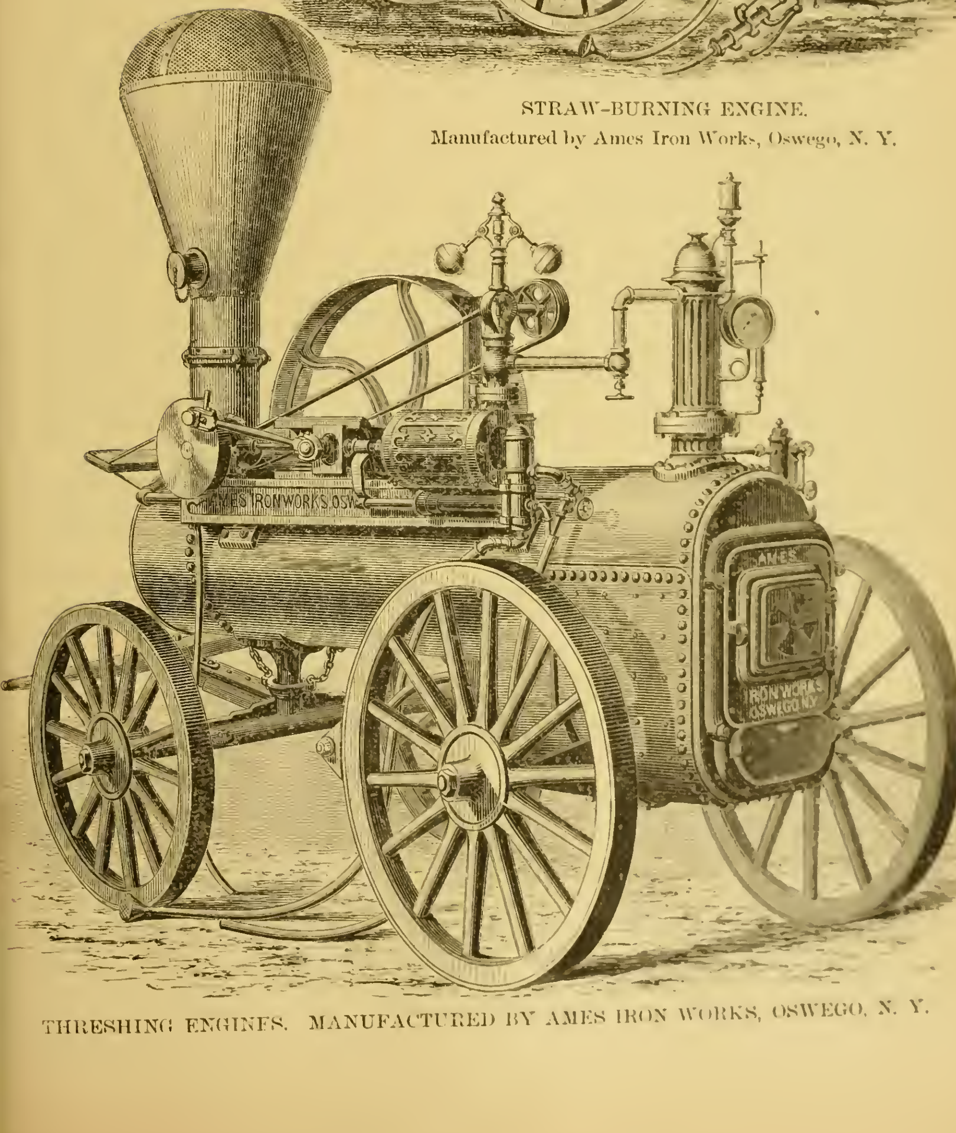
In the meantime, the first importation was made into New York from Holland by the Dutch West India Company, and the foundation laid for a valuable race of animals. The number in all introduced was one hundred and three, consisting of horses and cattle for breeding. The company furnished each tenant with four cows, four horses, some sheep and pigs, for the term of six years, when the number of animals received was to be returned, their increase being left in the hands of each farmer. Then the cattle belonging to the company were distributed among those who were unable to buy stock.

And so, for the settlements along the Delaware, cattle were introduced by the Swedish West India Company in 1627. It will be seen, therefore, that before the close of the year 1630, the number of horned cattle in all the colonies must have risen, by natural increase and by the importations above named, to several thousands.

And then, in 1631, 1632, and 1633, several importations were made into what is now New Hampshire, by Captain John Mason, who, with Gorges, procured the



STRAW-BURNING ENGINE.
Manufactured by Ames Iron Works, Oswego, N. Y.




THRESHING ENGINES. MANUFACTURED BY AMES IRON WORKS, OSWEGO, N. Y.

patent of large tracts of land in the vicinity of Piscataqua river, and immediately formed settlements there. The prime object of Mason was to carry on the manufacture of potash, and for this purpose he employed the Danes; and it was in his voyages to and from Denmark that he procured many Danish cattle, chiefly for the purposes of draught. They were, undoubtedly, considerably larger than the average of the cattle of England at that day, of a uniformly light yellow color, and made very fine oxen for labor. They soon became widely diffused over the whole region, and are said to have remained, with a great degree of purity of blood, or little intermixture, down to the year 1820. Traces of them can be found even at the present day. They were, no doubt, large and coarse animals, and well adapted to endure the severity of the climate and the hardships to which they were subjected in the lumbering operations of that new colony. They, unquestionably, did much to lay the foundation of the "native" stock of New England, over which they spread in the course of a very few years, and became mixed with the cattle imported into Salem and Plymouth, and probably, to some extent, with the Dutch cattle already alluded to; perhaps, also, with the black cattle of Spain and Wales, and subsequently with the long-horns and the short-horns, most or all of which crosses were accidental, or the result of individual convenience or other local circumstances. From them the working oxen of New England derive much of their character and reputation for strength, hardihood, quickness, and docility.

Now we find the sources from which the native cattle of this country sprang. The early importations into Virginia were originally derived, mainly, probably, from England; some were from the black cattle of Spain, though the importation of 1611 probably came from England; the cattle of the Plymouth colony came from the coast of Devonshire; those brought into New York from the island of Texel, on the coast of Holland, and were mostly, without doubt, the black and white Dutch cattle; those on the Delaware were brought from Sweden; those in New Hampshire were the large, yellow Danish cattle; and as the earlier importations were the most extensive that were made for many years, these various stocks were crossed, and thus formed the original stock of the country.

There is sufficient evidence to show that they were interchanged between the colonies to some extent, at an early day. Some of the Virginia cattle were early sent to New England, while others found their way to Virginia through Pennsylvania, so that the mixture was great and inevitable. Of the mode of keeping cattle in the Virginia colony, Glover, a cotemporary, in the *Historical Register*, says: "All the inhabitants give their cattle in winter is only the husks of their Indian corn, unless it be some of them that have a little *wheat straw*, neither do they give them any more of these than will serve to keep them alive; by reason whereof they venture into the marshy grounds and swamps for food, where very many are lost." And Clayton, another equally high authority, says, "that they neither housed nor milked their cows in winter, *having a notion that it would kill them.*" And still another, a Swedish traveller, Kalm, more recently, 1749, in speaking of the James river colony, says: "They make scarce any manure for their corn fields, but when one piece of ground has been exhausted by continual cropping, they clear and cultivate another piece of fresh land, and when that is exhausted proceed to a third. Their cattle are allowed to wander through the woods and uncultivated grounds, where they are half starved, having long ago extirpated almost all the annual grasses by cropping them too early in the spring, before they had time to form their flowers or to shed their seeds." The poorness of pasturage and want of food had caused the cattle to diminish in size from one generation to another, till they had become stunted and small, and were not improperly termed "little runts," or "natives."

In color, the natives, as already indicated, are exceedingly various. Crosses of the Denmarks with the Spanish and Welsh would naturally have made a dark brindle; crosses of the Denmarks and the Devons often made a lighter or yellowish brindle; while the more recent importations of Jerseys and short-horns have generally produced a beautifully spotted progeny. The prejudice in favor of deep red, which was long the favorite color of New England, is fast giving way to more variegated colors.

In the year 1553, some Portuguese had taken cattle to Newfoundland and Nova Scotia, while in 1604, a Frenchman had introduced the small French cattle into Acadia, from whence, in 1608, they were carried to Canada, and from there several animals were taken into what is now known as the "American Bottom," in Illinois, in 1682, where they increased rapidly. The first cattle imported into Carolina were obtained in England in 1670, and we find that the Indians on the Red River in Louisiana had cattle as early as 1690. The first importation into Georgia was made, so far as we are informed, in 1732, followed by others in 1735.

In 1750 the keeping of stock had assumed some importance in certain localities, particularly in the older eastern settlements, where it had become comparatively safe from molestation, for it is known that some large farmers in Rhode Island kept as many as one hundred cows and upward, and the sale of thirteen thousand pounds of cheese from one farm is recorded, and in one case seventy-three cows produced ten thousand pounds of butter in five months, or an average of very nearly a pound a day to a cow, which, for that length of time, must be regarded as a good yield.

It will be borne in mind that up to this time, and in fact for nearly half a century later, no well-directed efforts at improvement had been made even in England; but at that time some localities there possessed classes or races of animals peculiar to themselves, whose merits had begun to attract attention, though there was no general interest in the subject before the days of Bakewell, who "sat in the huge chimney corner of a log kitchen, hung round with the finest joints of his dried oxen, preserved as specimens of proportions; a tall, stout, broad-shouldered man, of brown, red complexion, clad in a brown, loose coat and scarlet waistcoat, leather breeches, and top boots," and demonstrated what could be done by attention to true physiological laws in the breeding of cattle. The choice of breeds and obtaining good crosses were nowhere thought of previous to his time. In fact, before the cultivation of the natural and artificial grasses and the introduction of the turnip and other root crops, the farmer had comparatively little control over the frames of his cattle. He was obliged to give them such food as he had, or rather they were obliged to take such as they could get, which, on a vast majority of the farms, both of England and the American provinces, at that time, was what would now be considered pretty hard fare. Hard seasons and the want of winter feeding and shelter were obstacles vastly more difficult to overcome then than now.

Those who should, "during the space of one year, keep the greatest weight of horned cattle," got the premiums offered by the London Society of Arts, rather than those who should exhibit the greatest degree of improvement in their animals. But with the increase and abundance of good food, the tide of improvement set in, and size began to be the grand aim of the earlier graziers, and the production of enormous monstrosities was the result. Now Bakewell, a man of remarkable sagacity and close observation, steps in and establishes a new system of animal development. With him mere size was no object. He wanted to build up a breed which should give the greatest amount of saleable beef for the amount of food consumed, having the best parts bearing a larger proportion to the offal than what was usually found. Smallness of bone, and tendency to fatten and mature early, he thought indispensable in cattle bred for the shambles. Up to his day, both in England and America, it had been customary to keep oxen till they were seven or eight years old, before they were fatted for the butcher. He travelled over England, Ireland, and Holland to find animals adapted to his purposes. "The old notion was," says Arthur Young, "that where you had large bones there was plenty of room to lay the flesh on. This, Mr. Bake well has proved to be a mistake. He asserts the smaller the bones, the truer will be the make of the beast, the quicker she will fatten, and her weight will have a larger proportion of valuable meat." The greatest physiologists have shown, upon the highest scientific principles, that the formation of a large bony system is the result of defective nutrition.

Other breeders, stimulated in part by Bakewell's efforts, and the wide and honorable reputation he achieved, immediately entered the field of competition, and Chaplin became the champion of the Lincolnshire sheep, as Bakewell of the Leicesters; and the brothers Charles and Robert Colling directed their efforts to improving the short-horns, as Bakewell the long-horns; while the Duke of Bedford, Quartly, and others, not to be outdone, espoused the claims of the Devons, and Benjamin Tomkins those of the Herefords. So successful were these enterprising breeders, both in preserving purity of blood in their stock, and in extending the reputation of their several herds, that at Charles Colling's sale on the 11th of October, 1810, Comet was bid off at 1,000 guineas, or $5,000, and many other animals about as high in proportion; the forty-eight head sold, including considerable young stock, bringing no less than $35,579. The cow Lily, sired by Comet, brought 410 guineas, or $2,050; the bull Petrarch, also by Comet, sold for 365 guineas, or $1,825, and the calf Cecil for 130 guineas, or $650. There were seventeen cows, eleven bulls, seven bull calves, seven heifers, and five heifer calves, for which this successful breeder received an average of $741 a head. That sale, and that of Robert Colling in 1818, that of Lord Spencer in 1846, that of the Bates, or Kirkleavington herd in 1850, that of Lord Ducie two years later, and some still more recent and extensive sales, are the marked eras in the history of the short-horns in England, and it was through these sales, and the universal enthusiasm awakened by them, that the short-horns have become more widely spread over Great Britain, and more generally fashionable than any other breed.

Tomkins began with the Herefords in a small way about the year 1766, and at his decease in 1819, his whole herd, consisting of fifty-two animals, including twenty-two steers, and varying in age from calves to two-year-olds and upward, was sold at auction, and brought an aggregate of $23,368, or over $445 a head; one bull sold to Lord Talbot for $2,943, while several cows brought from $1,000 to $1,200 a head.

Both these breeds are celebrated for early maturity. Either of them may be prepared for market at two or three years of age, far better than the old style of cattle could be at five, six, and seven years, and be of nearly equal weights. I have mentioned these facts to show how it was that the average weight o cattle sold in the Smithfield market increased from 370 pounds in 1710, to over 800 pounds at the present time. A select committee of the House of Commons, in a report printed in 1795, after a full investigation, stated that since the year 1732, their neat cattle had, on an average, increased in weight and size at least one-fourth, or twenty-five per cent., which would fix the average weight in 1795 at about 462 pounds. The average age had formerly been over five years. In 1830, owing, in a large measure, to the enthusiasm which had been created, commencing first by the efforts of individuals, and radiating out through the community in every direction, the average weight had increased to 656 pounds, an increase, in twenty-five years, of more than forty per cent. in weight, while the average age had been reduced to four years instead of five. What a contrast! A saving of one whole year's consumption of forage, and an increase of forty per cent. in the profitable results, in the course of a quarter of a century! But since then the average age has been still further reduced, and the average weight a good deal increased.

Such being the striking results in England, it is not surprising that when an interest was awakened in the improvement of our agriculture, a desire was felt by intelligent breeders to avail themselves of the advantages which had already been gained abroad. Importations began, and a more systematic course of breeding was adopted; at first, by a very limited number of enterprising farmers, till, within the last twenty years, that number has rapidly increased, and the results have become more marked and perceptible.

It may be remarked in passing, that two modes of improvement were open to the farmer and breeder, either of which, apparently, promised good results. The first was to select from among our native cattle the most perfect animals not known or suspected to belong or to be related to any of the well-established breeds, and to use them as breeders. This mode of improvement is simple enough if adopted and carried on with animals of any known race or breed, and, indeed, it is the only course of improvement which preserves the purity of blood. This was chiefly the course adopted in England by Bakewell with the long-horns, by the Collings and others with the short-horns, by Tomkins, Price, and others, with the Herefords, and by the Duke of Bedford and others with the Devons. Had they resorted to any other, they would have run the risk of a total failure and ruin of those valuable races. Their object was not to build up a new breed by crossing, so much as to improve and perfect the races, already valuable, which were to be found in particular localities or counties, which gave them their name.

But our circumstances were entirely different. We had no race and no breed of cattle among us. The term *race*, properly understood, applies only to animals of the same species, possessing, besides the general characteristics of that species, other characteristics, which they owe to the influence of soil, climate, nourishment, and habits of life to which they have long been subjected by man, and which they transmit with certainty to their progeny, and it is essential that they should have possessed these characteristics from a time to which "the memory of man runneth not to the contrary." The term *breed*, on the other hand, applies to a family of animals built up by a long series of careful breeding, till certain desired characteristics become fixed, capable, and sure of being transmitted. As might be supposed, the characteristics and peculiarities of *races* are more inherent, more fixed and strongly marked than those of families, or breeds built up artificially. But in general the characteristics of both races and breeds are so permanent, and so well marked, that if an individual supposed to belong to any one of them were to produce an offspring not possessing them or possessing them only in part, with others not belonging to the race or breed, it would be just ground for suspecting a want of purity of blood.

This being the acknowledged, and only proper sense and use of these terms, it follows that no grade animals, and no animals not possessing fixed peculiarities or characteristics which they share with all other animals of the class of which they are a type, and which they are capable of transmitting with certainty to their descendants, can be recognized by breeders as belonging to any one distinct race, breed, or family.

The term "native," or "scrub," is applied to a vast majority of our American cattle, which, though born on the soil, and thus in one sense natives, do not constitute a breed, race, or family. They do not possess characteristics peculiar to them all, which they transmit with any certainty to their offspring, either of form, size, color, milking, or working properties. It does not follow, to be sure, that because an animal is made up of a mixture of blood, almost to infinity, he may not be, as an individual animal, and for specific purposes, one of the best of the species; and for particular purposes individual animals might be selected from among those commonly called "natives" in New England, and "scrubs" at the south and west, equal, and perhaps superior, to any among the families produced by the most skilful breeding, notwithstanding the fact that they have sprung from a great variety of cattle procured at different times on the continent of Europe, in England, and in the Spanish West Indies, brought together without any regard to fixed principles of breeding, but from individual convenience, and by accident; but it is true that our native cattle possess neither the size, the symmetry, nor the early maturity of the short-horns; they do not, as a general thing, possess the fineness of bone, the beauty of form and color, nor the activity of the Devons or the Herefords; nor do they possess that uniform goodness and quantity of milk of the Ayrshires, nor the surpassing richness of milk of the Jerseys; but above all they do not possess the power of transmitting the many good qualities, which they often possess in an extraordinary degree, to their offspring, which is a characteristic of all well-established breeds.

Now, to build up a breed, or family, on such a foundation, in the mode already indicated, requires great experience in selection, a quick and sure eye, and judgment of the true points in stock, a mind eminently unprejudiced, and a patience and perseverance perfectly indefatigable and untiring. It is absolutely necessary, also, to pay special attention to the calves thus produced—to furnish them at all times, summer and winter, with an abundant supply of nutritious food, and to regulate it according to their growth.

Few men could be found either capable or willing to undertake the herculean task of building up a new breed in that way from grade stock. A prominent and almost insuperable objection would meet them at the very outset, that it would require a long series of years—longer than the natural life of most men—to arrive at any very satisfactory results, from the fact that no two animals, made up, as our "native" cattle are, of such a variety of elements and crosses, could be found sufficiently alike to produce their kind. The principle that like produces like is perfectly true, and in the well-known breeds it is not difficult to find two animals that will be sure to transmit their own characteristics to their offspring; but with two animals which cannot be classed with any breed, the defects of an ill-bred ancestry will be liable to appear through several generations to thwart and disappoint the expectations of the breeder.

The second method is more feasible, and

that is, to select animals from races already improved and well-nigh perfected, to cross with our cattle, selecting such animals from the well-established breeds as are best calculated for the special purposes for which we want them. If our object is to improve stock for the dairy, taking such only as belong to a race distinguished for dairy qualities; or, if resort must be had to other breeds less remarkable for such qualities, such only as have descended from large and generous milkers. We ought to be able to rely with some confidence upon getting the qualities which we seek. Milking or dairy qualities do not belong to any one breed or race exclusively, though, as they depend mainly on structure and temperament, which are hereditary to a considerable extent, they are, themselves, transmissible. In almost every breed we can find individual milkers which greatly surpass the average of the cows of the same family, and from such, many suppose good crosses may be expected without much regard to other circumstances. It is not accidental good qualities that we want, so much as those which are surely transmissible. We do not want to breed from an animal—a cow for instance—that is an exception to the rule of her race or family. A good calf from her would be, to a great extent, the result of chance. We cannot expect nature to go out of her course, to give us a good animal, if we violate her known laws as developed by our knowledge of physiological structure.

Such are a few of the considerations which, no doubt, led the early importers of the modern improved foreign stock to make an effort on our native and grade cattle. What has been the result? It can be clearly shown that there has been a large increase in the number of the cattle of the country. Of that there could, of course, be no question, since this increase would naturally follow from an addition of new territory and the more perfect development of the agricultural resources of the country. But I think it can be clearly shown, also, that there has been a positive improvement in the intrinsic qualities of the common stock of the country as a whole. I am far from detracting from the merits of our native cattle. They are far better than could have been expected from the loose manner in which they were "made up." Many of them have great merit, and individual animals are to be found among them, as already remarked, which would be hard to beat by any pure bred animals. As working oxen, the native cattle of New England are unsurpassed by any in the known world, and they have the reputation of being so, both in other parts of this country and in Europe, where their qualities are known. But they have their defects, and it is useless to blind our eyes to them.

I expect, therefore, to be able to show that some actual progress has been effected upon the common stock of the country. But to what is this progress owing? Is it merely that which is due to better keeping, both summer and winter? I have already intimated that the treatment the cattle of the country received during the most of the last century was far from being calculated to improve them, scarcely, even, to keep them on foot. Even so late as 1841, Mr. Colman asserted that the general treatment of cows at that time, in New England, would not be an inapt subject of presentment by a grand jury. I was cognizant of the manner in which the stock was kept in many a country town at that time, and I am strongly inclined to agree with him; and, judging from the well-known anxiety of those who enter milch cows now for premiums at the fairs, to show that their yield has been enormous, and that they have lived upon little or nothing, one would suppose their keeping was not much improved, even yet.

But, as compared with the last century and the earlier part of this, there has been a vast improvement in the shelter, mode of feeding, and the general treatment, and this has, of course, had its effect in increasing their milking qualities and their appearance. But, apart from this, there can be little doubt, I think, that there has been a positive improvement in our stock as a whole; that is, the general average of the stock of New England is better than it was forty or fifty years ago. There were individual animals then, among the native or common stock of the country, whose yield of milk was quite remarkable, and would be, at the present day, and among the best stock of the present time; but we cannot, and ought not to reason from individuals, but from the general average stock of the country.

These remarks have special reference to the stock kept in the eastern and older sections of the country—those parts where the herds are small, and kept not so much for raising for beef as for their other products, as milk, butter, cheese, and labor.

In the great west, where cattle are reared for the Eastern and European markets, and early maturity and easy fattening are of prime importance, there has been a most gratifying advance in the intrinsic qualities of the stock. Every car load of these splendid cattle from Kentucky, Indiana, Illinois, and the states on the plains, demonstrates this most conclusively. Compare them with the cattle formerly brought from the west, and still raised in some of the Eastern States, and mark the contrast. Our cattle are now shipped to England for slaughter in large numbers, and immense quantities of fresh beef are exported which comes directly in competition with the best English beef, and is preferred to it. Our exports of fresh beef and beef on the hoof, in 1880, were nearly $21,000,000.

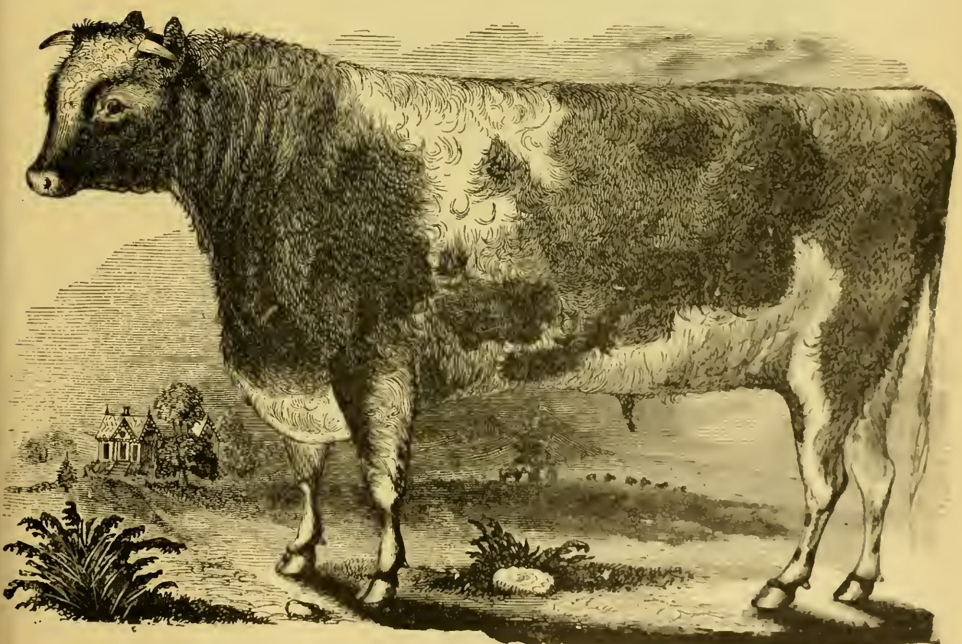
In 1880, there were 33,258,000 head of cattle in the United States, of which 12,027,000 were milch cows, and 21,231,000 other cattle, including working oxen and cattle raised for market or slaughter; and the latter were increasing at a very rapid rate. The estimated value of the horned cattle was $621,060,574. In the same year the number of sheep was estimated at 48,765,900, and their value at more than $105,000,000. There were 34,034,000 swine, valued at $145,781,515, 11,201,800 horses, valued at $613,296,611, and 1,729,500 mules, worth $105,948,319, making a grand total of value of live stock of about 1,591 millions of dollars. Now if by the keeping of better stock we add to their value and the profit derived from them, without increasing the cost, we make, of course an absolute gain on the receipts from the same amount of capital invested. A distinguished breeder places this in a clear light as follows: "Suppose that the thirty-three millions of neat cattle now in the United States, by the infusion of better breeds among them generally, should, in their earlier maturity and increased product of milk and flesh, with an equal consumption of food, and by a moderately increased amount of care, produce an additional profit of one-fifth, or only twenty per cent.—certainly a moderate estimate —the annual value of such improvement will be that which is derived from an additional invested capital of sixty millions of dollars; a vast sum in the aggregate of our agricultural wealth."

But to return to the importation of modern improved stock from abroad for the specific purpose of improving the stock of this country. In the year 1783, three gentlemen of Baltimore—Messrs. Goff, Ringold, and Patton—sent to England for superior cattle; and, in 1785, a bull from this importation was taken to Kentucky, followed, not long after, by another lot of the same importation. A half-breed bull was taken to the same section abont the year 1804, and is said to have greatly improved the stock of that state. Some of the cattle of that early importation were commonly called the "milk breed," and others the "beef breed." For a long time they went by the name of the "Patton stock." The beef breed were, probably, long-horns— large, coarse, and rough animals, but slow in maturing. The others are said to have been short-horns. Others were also taken from Virginia to Kentucky, but none of them were, probably, pure bloods, although the Patton stock gained a wide and deserved reputation.

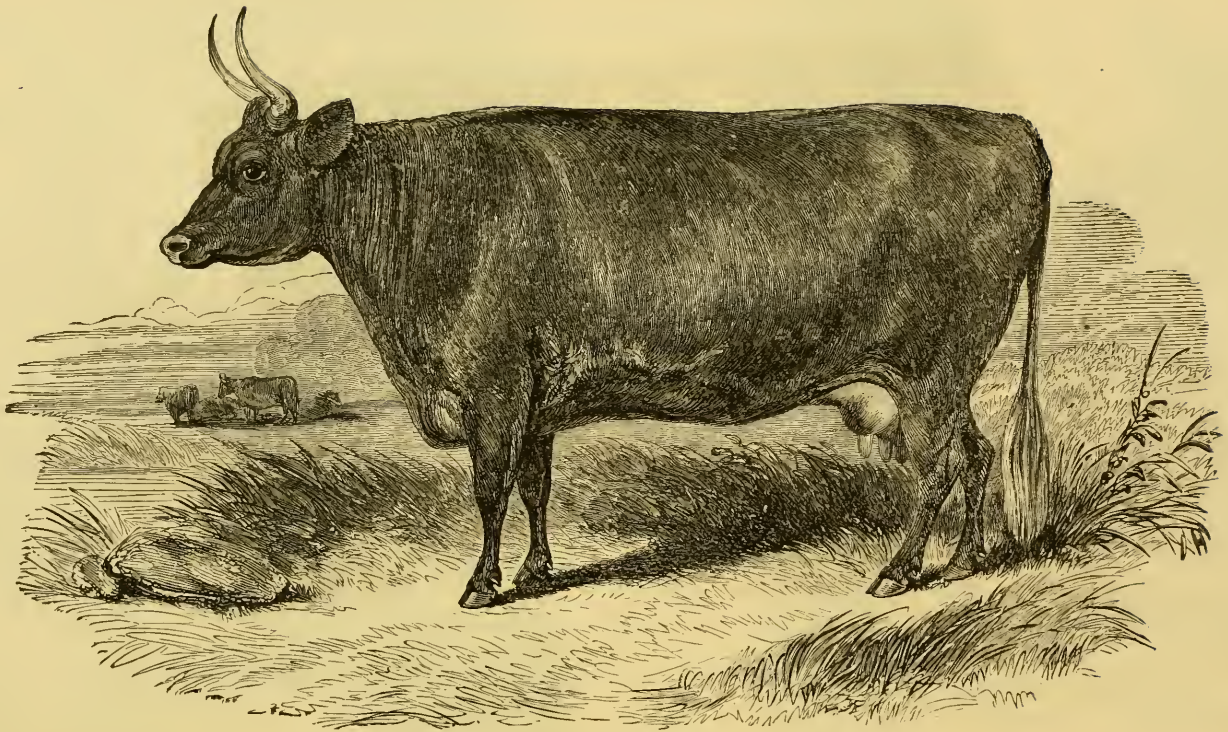
In 1817, Colonel Sanders, of Kentucky, sent for twelve head of the best that could be found in England. Six of them were short-horns, or Teeswaters. Two of these short-horns were also imported for Kentucky in 1818. These various importations, commencing with the first high-bred animals taken to the west in 1785, were the pioneers; and though the pedigree of some of them could not be given, they not only infused superior blood into the stock of that region, but excited a spirit of emulation among the farmers there which had an exceedingly salutary effect. There is little doubt that some of the best cattle in southern Ohio owe their origin to the early imported animals of Kentucky.

A few short-horns were brought into Westchester county, New York, as early as 1792 and 1796. They were kept pure for some years, but finally became scattered, leaving their descendants in that section to this day. Other importations into New York were made as early as 1816 and 1822. In July, 1818, a short-horn bull, widely known as "Cœlebs," and a heifer, "Flora," were imported into Massachusetts by Mr. Coolidge, and sold, in 1820, to Colonel Samuel Jaques, of Somerville. From "Cœlebs," by selecting superior native cows, Colonel Jaques succeeded in raising a fine milking stock, long known as the "Creampots." "Flora" had fourteen calves between 1819 and 1833, ten of which were by "Cœlebs." The same

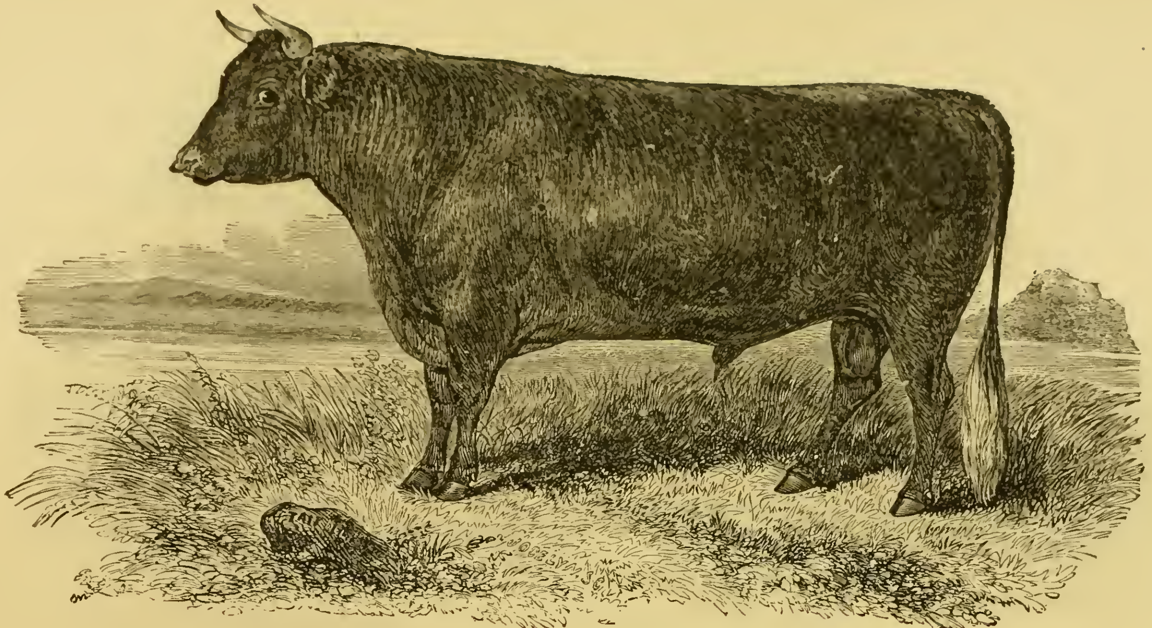
MILCH COW.



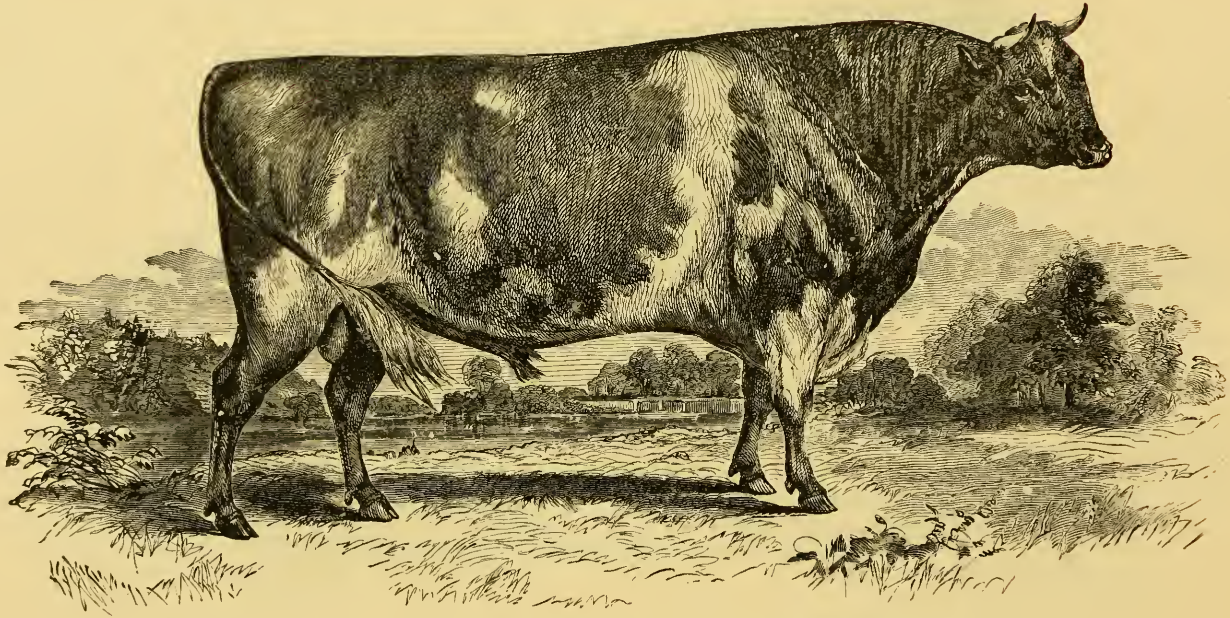
SHORT-HORN BULL. DOUBLE DUKE.



JENNY.



DEVON BULL. TECUMSEH.



AYRSHIRE BULL.

year (1818), also, Gorham Parsons, of Brighton, Massachusetts, imported a pure breed short-horn bull, called "Fortunatus," or "Holderness," and his descendants were widely disseminated through New England. Another short-horn bull was brought into Massachusetts by Theodore Lyman, of Boston, from whence he was shortly after sent to Maine; and, in 1825, Mr. W. Pierce, of Portsmouth, New Hampshire, imported a celebrated short-horn, "Nelson," and the cow "Symmetry," the parents of the great ox "Americus," so large as to be taken about on exhibition, for which purpose he was afterward taken to England.

It was also in 1818 that Stephen Williams, of Northboro', Mass., imported the famous bull "Young Denton," the sire of many very excellent grade animals, the heifers proving fine milkers. Many other fine short-horns were taken into Massachusetts after the year 1820, but though they left some superior grades, they were not appreciated by the farmers generally, and attention was gradually directed to other breeds. New England, as a whole, is not the place for short-horns. They do better on more luxuriant pastures. Besides, they are not well adapted to the wants of the small dairy farmer, especially since the modern improvements of this justly celebrated breed have taken all the milk out of them. For a region better adapted to raising beef, and on naturally rich feed, they are unsurpassed for beauty and symmetry of form, for size and early maturity, and consequently for the profits they yield to the breeder and the grazier.

In 1824, Mr. Powell, of Philadelphia, commenced the importation of short-horns, and continued to breed them with great enterprise and success for many years. He had frequent sales, some of his stock going into Kentucky, others to Ohio, and elsewhere.

But the great impulse given to the importation of short-horns, was the formation of the Ohio Company for Importing English Cattle, in 1834. The sum of $9,200 was subscribed in shares of $100 each, and agents sent abroad, who returned with nineteen head, selected from the herds of celebrated breeders, arriving in October of that year. They were kept together under the care of an agent, and the number was increased by other importations till 1836, when they were sold at public auction and scattered extensively over Ohio. A dividend of $280 per share was immediately declared on the ninety-two shares, amounting to $25,760. The following year they made another extensive importation, which sold rapidly and well. Immense benefits have resulted from these efforts.

The sketch given above of some of the earlier importations of short-horns, has been somewhat extended for the purpose of showing the gradually increasing and extending interest and enterprise in breeding, but since 1840, importations of this magnificent breed have so far multiplied, that it would be out of place to attempt to follow them. The cream of the finest and most celebrated herds in England has been taken to this country, without regard to cost. Fabulous prices have been asked, and five and six thousand dollars for a single animal have, in some cases, been paid, to which was added the cost of transportation. So successful, indeed, have the more recent efforts been, that England has sent over here to buy short-horns from us; and so admirably adapted to stock raising is the climate of Kentucky, that this fine breed has been improved there to such an extent, that very few of the last 150 cows selected from among the best in England, could win the prizes from those born and bred on our native soil.

These superior animals are not all held in the hands of a few. They are within the reach of thrifty farmers, who are now awake to the profit of raising cattle that will make as much beef at two or three years old, as a native at double that age.

It is proper to refer very briefly to the efforts made at various times to introduce and experiment with the other well-established English breeds, and the success which has attended these efforts.

In 1817, the Hon. Henry Clay, of Kentucky, made an attempt to introduce the Herefords into that state, by the purchase of two bulls and two heifers, at a cost of £105, or about $500. This was the first well authenticated importation of this breed of any note. The Herefords belong to the class of middle-horned cattle, and were indigenous to certain districts of England, where they were known as far back as tradition extends. They have undergone considerable changes within the last hundred years, commencing with the efforts of Tomkins, already alluded to—not however, by means of crosses with other races, but by careful and judicious selections.

In point of symmetry and beauty of form, the well-bred Herefords may be classed with the improved short-horns, arriving, perhaps, a little slower at maturity, though remarkably inclined to take on fat. They never attain to such weights, but they generally arrive at the Smithfield market at two or three years old, and so highly is their beautifully marbled beef esteemed, that it is eagerly sought by the butchers at a small advance, pound for pound, over the short-horn. Weighing less than the short-horns, they yield a larger weight of tallow, which is one reason of the preference for them. The short-horn produces more beef at the same age than the Hereford, but consumes more food in proportion.

They have never been bred for milking or dairy qualities, and no farmer would think of resorting to them for that purpose.

In 1824, Admiral Coffin, of the royal navy, presented the Massachusetts Society for Promoting Agriculture, a Hereford bull and heifer, bred by Sir J. G. Cottrel from the Tomkins stock. The bull was kept by the Hon. J. C. Bates, of Northampton, Mass., and left a numerous progeny, which was very highly esteemed in that neighborhood. The largest importation into this country was that of Messrs. Corning and Sotham, of Albany, N. Y., in 1840, consisting of five bulls and seventeen cows and heifers. Other importations of the same breed were added to this herd in subsequent years. The Hon. L. A. Dowley, of Boston, imported several animals of the same breed in 1852, a part of which were kept for some time on the State Farm at Westboro', Mass., and were afterward sold to Mr. John Merryman, of Baltimore Co., Md., who has one of the largest and finest herds of Herefords in the country.

It will be readily seen from the characteristics of the race, as stated above, that they would be ill adapted to the wants of New England farmers as a general thing. They are profitable for the grazier; though, in a country of extreme fertility, like many parts of the west, and capable of bringing the short-horns to their highest development and perfection, they might not, on the whole, be able to compete successfully with them.

The importation of Devons into this country has been more numerous. Indeed, there are some who assert that the native cattle of New England owe their origin chiefly to the Devons, since the cattle first brought into the Plymouth colony are pretty well known to have been shipped on the Devonshire coast. But that they were any thing like the modern Devons there is little evidence; they certainly have very few of the highest characteristics of that race left. The general impression has arisen mainly from the fact that many of the native cattle of New England are red, and that is the favorite color.

However this may be, the improved North Devon is a very different animal from any that could, at that day, have been procured on the coast of Devonshire, or, in fact, anywhere else. This race dates further back than its history goes. It has long been bred for beef, and for the working qualities of its oxen, which, perhaps, excel all other races in quickness, docility, and beauty, and the ease with which they are matched. But as milkers the North Devon cows do not excel, nor indeed do they equal, some of the other breeds.

Some years ago a valuable importation was made by Mr. Patterson, of Baltimore, Md., who has bred them with special reference to developing their milking qualities, and now they would be remarkable as dairy stock as compared with any other pure breed, but they are very different animals from the common modern improved Devons, the dairy qualities of which have been very much disregarded.

The North Devons were also imported by the Massachusetts Society for Promoting Agriculture, and were kept together for some time, and then disposed of. So far as size is concerned, they are better adapted to New England farms than either the short-horns or the Herefords, while the form and color are so beautiful as to make them admired by many. But the milking qualities having been to a considerable extent bred out of them, especially those more recently imported, we have little to gain by preferring them over our native stock. They are good for beef, for which purpose they are chiefly raised in their native country, but the production of beef throughout most of the older sections of the country is an entirely secondary object. They are good for labor, on account of their quickness and ease of motion, but New England has equally good working oxen in its natives. They give rich milk, but the Jerseys give richer.

The Ayrshires and the Jerseys are, and have for a long time been bred with special reference to the dairy. The former, though a comparatively recent breed, were early imported into this country, and, I think, have, as a whole, proved very satisfactory, particularly as giving valuable crosses with our common stock. Grade Ayrshires are among the best animals for the use of small and dairy farms, and the cross-breds are, for all practical purposes, equal to the pure breds.

One of the cows originally imported by John P. Cushing, of Massachusetts, gave in one year 3,864 quarts of milk, beer measure, being an average of over ten quarts a day for the year; and the first Ayrshire cow imported by the Massachusetts Society for Promoting Agriculture, in 1837, yielded sixteen pounds of butter a week for several weeks in succession on grass-feed only. Our climate is not so favorable to the production of milk as that of England and Scotland. No cow, imported after having arrived at maturity, could be expected to yield as much under the same circumstances, as one bred on the spot where the trial is made, and perfectly acclimated. The Ayrshire cow generally gives a larger return of milk for the food consumed than a cow of any other breed.

Within the last 35 years the Jerseys have been extensively imported into this country by the Massachusetts Society for Promoting Agriculture, and by many individuals in New England, New York, Maryland, Ohio, Illinois, and Iowa. They give richer milk than any other known breed, but the quantity is less than that yielded by the Durham or Hereford, which makes them unprofitable for the dairyman. They are usually small in body, and rather large consumers. On a dairy farm devoted exclusively to the making of butter, an infusion of Jersey blood is highly desirable. One or two Jerseys in a herd of twenty will often make a perceptible difference in the quantity and richness of butter. As the production of butter has become a science, and its export has been largely increased, the infusion of Jersey and Alderney blood in the butter dairies has become much more general, and there has also been a considerable admixture of Holstein and Brittany cattle, both breeds yielding rich and excellent milk. Among the western dairy-farmers the Holstein cattle are preferred, and there is no finer butter made than some of theirs.

The influence which the introduction of superior foreign stock has exerted, has not been confined to their own intrinsic merits, nor to the actual improvement which they have effected by means of crossing upon the common stock of the country. It has led to better treatment of native stock, partly by increasing, to some extent, the interest in cattle and the knowledge of their wants and requirements, and partly from the fact that there was a general disposition among the mass of farmers to say that if the natives were kept as well, they would outstrip the fancy stock.

But still the improvement in the common stock of the eastern and middle states, or those portions devoted to the dairy and other stock interests than the raising of beef, over and above what can be ascribed to better treatment, has been small compared with what it has been in those states devoted more exclusively to grazing. During the past thirty-five years, for example, the live stock of Ohio has increased in valuation—according to the official returns made to the state auditor—more than two hundred per cent., while, in the same time, no class of stock has increased in numbers one hundred per cent. A part of this, to be sure, may be fairly ascribed to an increased demand for stock, and a consequent higher value, but there can be no question that intrinsically better animals have superseded the inferior native stock to a considerable extent. The number of horned cattle in that state, in 1836, was 372,866, valued at $2,982,928. In 1846 the number had increased to 920,995 head, and the valuation to $7,527,123. In 1850 the number was 1,103,811, and the valuation $11,315,560. In 1880 the number was 1,492,750, and the valuation was $36,244,730 The ratio of increase in value has been accelerated since the means of communication by railway have so greatly increased. When the first great importation and sale was made, in 1834–6–7, it was not accessible to the mass of cattle breeders, and acquired more of a local than a general reputation. What is true of Ohio is true to a still greater extent of Illinois, Wisconsin, Iowa, and most of the other western states.

While speaking of the different objects for which cattle are kept in various parts of the country, it may be interesting to compute the actual products, per cow, in butter and cheese in the several sections. According to the census of 1850, the average number of pounds of butter produced per cow, per annum, in the various states, was as follows:—

| | lbs. per cow. | | lbs. per cow. |
|---|---|---|---|
| Washington | 25 9 | W. Virginia | 48 3 |
| Nebraska | 53.2 | Montana | 32.9 |
| Florida | 1.6 | Nevada | 18.0 |
| Texas | 8.9 | Illinois | 56.3 |
| California | 48.6 | Maryland | 52.9 |
| Oregon | 29.3 | Indiana | 58.2 |
| Georgia | 19.7 | Iowa | 74.4 |
| South Carolina | 14.8 | Delaware | 48.7 |
| North Carolina | 21.0 | Wisconsin | 72.7 |
| Alabama | 18.8 | Massachusetts | 57.1 |
| Arkansas | 21.4 | Ohio | 76.9 |
| Mississippi | 15.0 | Minnesota | 78.4 |
| Tennessee | 39.3 | Maine | 83.5 |
| Missouri | 36 3 | Michigan | 97.3 |
| Kansas | 40.7 | New Hampshire | 65.8 |
| Virginia | 37.0 | Connecticut | 68 0 |
| Rhode Island | 50.0 | Pennsylvania | 86 3 |
| Kentucky | 48.0 | New Jersey | 62.0 |
| Louisiana | 3 1 | Vermont | 98.9 |
| Colorado | 15.7 | New York | 79.9 |
| Idaho | 27.0 | Dakota | 50.5 |

Some of the states, like New York, for instance, sell vast quantities of milk in its natural state, and yet the quantity of butter per cow will be found to be large compared with those states where cattle are kept more especially for beef. To conclude that the stock of Kentucky, Illinois, or Ohio is inferior to that of New York, because the yield of butter per cow is inferior, would be premature. The objects for which the stock of those states is kept are different, and for the purpose of grazing the cattle of the western states may be far better adapted than any other would be.

Let us now see what is the amount of cheese annually produced per cow in the several states. In some of them it appears to be infinitesimally small. The list stands as follows, beginning with a hundredth part of a pound:

| | lbs. per cow. | | lbs. per cow. |
|---|---|---|---|
| Florida | 0.01 | Nebraska | 1.59 |
| South Carolina | 0 08 | Oregon | 1.64 |
| Mississippi | 0.25 | Illinois | 2.59 |
| Georgia | 0.29 | Pennsylvania | 1.62 |
| Louisiana | 0.91 | Utah | 3.96 |
| Alabama | 0.06 | Iowa | 2.91 |
| Maryland | 0.14 | Minnesota | 1.92 |
| Arkansas | 0.06 | Wisconsin | 5 16 |
| North Carolina | 0.26 | California | 20.69 |
| Delaware | 0.08 | Rhode Island | 4.36 |
| Texas | 0.85 | Michigan | 2.67 |
| Tennessee | 0.58 | Maine | 8.27 |
| Kentucky | 0.47 | New Hampshire | 9.37 |
| Missouri | 0.51 | Connecticut | 2.05 |
| Virginia | 0.38 | Ohio | 12.82 |
| Kansas | 1.83 | Massachusetts | 19.57 |
| New Jersey | .29 | New York | 16.86 |
| Indiana | 0.72 | Vermont | 26.79 |

The total number of pounds of cheese produced in the United States in 1870 was 53,492,153, of which 22,769,964 pounds—about 40 per cent.—was made in the state of New York, 8,169,486 in Ohio, 4,130,700 pounds in Vermont, 2,245,873 in Massachusetts, 2,031,194 in Connecticut, 1,145,209 in Pennsylvania, 849,118 in New Hampshire, and 3,395,074 in California. The other thirty-nine states and territories only made about nine million pounds in all. This production was equivalent to about one and two-fifths pounds to each inhabitant. The export in 1870 was 57,296,327 pounds. The manufacture of both butter and cheese has greatly increased within the decade 1870–1880. There are in the United States over 1,200 factories for making butter and cheese, using the milk of about 700,000 cows. We have no reliable statistics of the quantity of either butter or cheese made since 1870, as these statistics can only be obtained (and not very accurately even then) by the machinery of a general census. The exports of cheese in 1880 were 137,911,559 pounds of an invoiced value of $1[illegible],717,447. The export of butter in the calendar year 1880 was 37,422,479 pounds at an invoiced value of $7,389,578; that of the year 1879 was 43,280,166 pounds, but the invoiced value was only $6,471,772. Let us now consider the proportion of cows kept in the various states to the population. We give the proportion of milch cows in 1880, and the census population of that year, as the latest available, and have added the average value of cows in each state the same year. The proportion to the population is stated in decimals:

| State. | No. cows per head to population. | Average value of cows. | State | No. cows per head to population. | Average value of cows. |
|---|---|---|---|---|---|
| Maine | 0.25 | 24.10 | Louisiana | 0.12 | 18.00 |
| New Hampshire | 0.29 | 28.00 | Texas | 0.36 | 13 85 |
| Vermont | 0.62 | 25.05 | Arkansas | 0.25 | 13.66 |
| Massachusetts | 0.09 | 35.00 | Tennessee | 0.16 | 17 09 |
| Rhode Island | 0.08 | 30.00 | West Virginia | 0.21 | 20.97 |
| Connecticut | 0.19 | 29.37 | Kentucky | 0.16 | 22.62 |
| New York | 0 28 | 29.06 | Missouri | 0.24 | 19.21 |
| New Jersey | 0.13 | 35.10 | Illinois | 0.23 | 26.63 |
| Pennsylvania | 0.19 | 26.66 | Indiana | 0.22 | 25.09 |
| Delaware | 0.17 | 32.50 | Ohio | 0.22 | 26.44 |
| Maryland | 0.16 | 27.20 | Michigan | 0.25 | 26.68 |
| Virginia | 0.16 | 18.86 | Wisconsin | 0.25 | 21.79 |
| North Carolina | 0.16 | 12 60 | Minnesota | 0.39 | 20.16 |
| South Carolina | 0.13 | 15 25 | Iowa | 0.45 | 24.20 |
| Georgia | 0.18 | 13.26 | Kansas | 0.35 | 23.68 |
| Florida | 0.27 | 9.27 | Nebraska | 0.32 | 26.00 |
| Alabama | 0.17 | 13.50 | California | 0.55 | 28 65 |
| Mississippi | 0.17 | 13.06 | Oregon | 0.70 | 17.71 |

The products from stock might be stated in another interesting point of view as follows. The northern states, comprising New England, New York, New Jersey, and Pennsylvania, with 169,668 sq. miles, and a population of 14,508,077, keeping 3,195,800 milch cows, produced, according to the estimates of 1880, more than 700 million pounds of butter, 250 million pounds of cheese, and 370 millions of gallons of milk sold. They kept, also, 2,121,500 oxen and other cattle, not, of course, including horses, sheep, or swine. At the same time the western states, and the territories, with an area of 1,942,242 sq. miles, and a population of 16,963,006, had 5,292,900 milch cows, and manufactured 595,000,000 pounds of butter and cheese, valued at $99,350,000. They had also 8,789,100 oxen and other cattle. The southern states, with 891,032 sq. miles, and a population of 19,681,853, had 3,538,300 milch cows, and manufactured 123,870,500 pounds of butter and cheese, valued at $29,780,325. They also had 10,320,400 working oxen, and 7,450,290 other cattle. The aggregate number of neat cattle was given in 1840 at 14,971,586, and in 1850 at 17,778,907. The amount of butter produced in 1850 was 313,266,962 pounds, and that of cheese 105,535,219 pounds; neither of which were given in 1840 as separate items. We had, in 1850, 1,700,744 working oxen; and of other cattle 16,078,163. The entire number of milch cows in 1860 was 8,581,735; of working oxen, 2,254,911, and of other neat cattle, 14,779,373, making a total of 25,618,019. The amount of butter produced in 1860 was 459,681,372 pounds, and of cheese 103,663,927 pounds. The entire number of milch cows in 1870 was 8,935,332; of working oxen, 1,319,271; and of other cattle, 13,566,005, making a total of 23,820,658, or 1,797,361 less than 1860. This was due to the great demand of cattle for slaughter, and the cattle raids of the great war of 1861–5, and perhaps also to imperfect enumeration from the unsettled condition of the country; for the loss was wholly in the oxen and other cattle, the milch cows having increased in the decade 353,597. The amount of butter produced in 1870 was 514,092,683; pounds of cheese, 53,492,153, of gallons of milk sold, 235,500,599. For 1880 the census report of milch cows, oxen and other cattle is not yet published: but the Dairy and Live Stock Associations estimate the number of cows at about 15,000,000. and oxen and other cattle at 25,000,000. The amount of butter produced is estimated at 1,500 million pounds, of cheese at 600 million pounds, and of milk sold at 570 million gallons.

HORSES.

That the horses in this country have undergone a vast change and improvement during the last century—or, rather, during the last eighty years—there can be no doubt. A simple change in the uses to which horses are put would naturally have produced a change in the horses themselves, without any well-directed effort at breeding. For, in the last century, the chief means of carrying on our inland business, including a vast amount of heavy transportation, was the horse. The roads were generally in a most wretched condition. They were seldom built of any thing but the natural soil thrown up from the sides, and often not this. The forest was felled, and the ground left for many a thousand miles without the precaution of making any side ditches at all, and over such a pathway the freight of a great part of the country was to be moved, in wagons made so as to be capable of the hardest usage. Over such roads light carriages would have been comparatively useless, and a speed now seen every day would have been unsafe for them. The mail contracts over a very large part of the country were made at a speed lower than four and five miles an hour, and heavily loaded teams, and heavy mail and passenger coaches, kept the roads for a considerable part of the year in a state not calculated to encourage fast driving. The farmer had to haul his produce often long distances to market, and needed a heavy kind of horse. Now he has a market almost at his very door. As many horses are now required, and even more than before, but their work is very different. The vast improvements in agricultural implements have also lightened the labors of the horse. Our wagons are of lighter construction, our plows run easier, our lands are freer from rocks and stumps, and quick, hardy horses often take the place of oxen, and of the larger, heavier, and much slower horses of half a century ago.

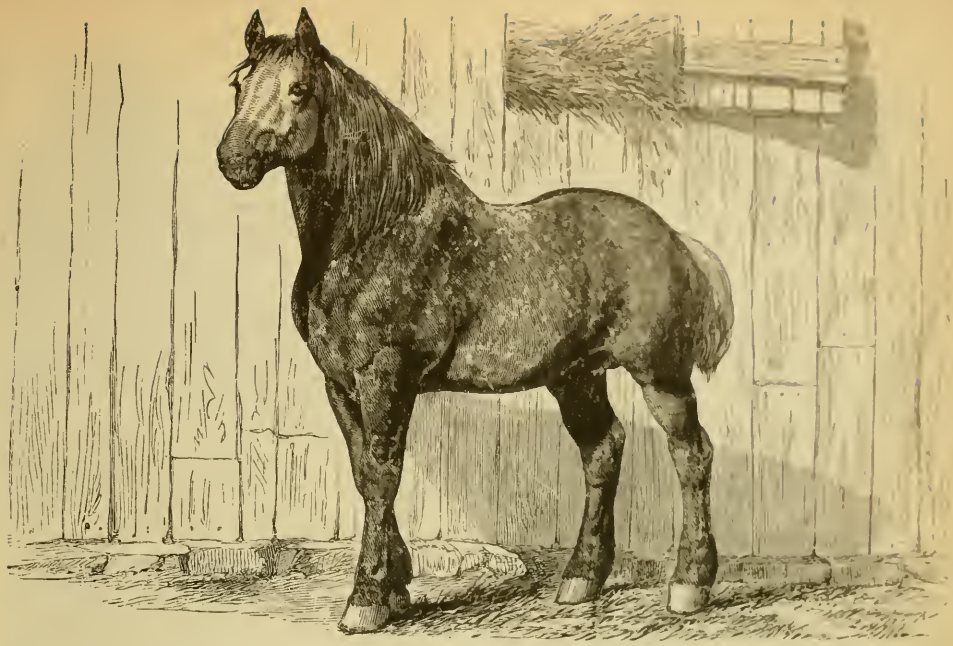
The farmer or the country gentleman who is accustomed to ride in the cars at the rate of thirty or forty miles an hour, would not be satisfied to step out of them and have to travel at the rate of five or six miles an hour. Speed, formerly little required, is now considered an indispensable requisite in a good horse, and though our horses are made up, as we shall see, of almost, if not quite as great a variety of blood, and with as little regard to the true principles of breeding, as our native cattle, yet they are, in many respects, distinct from all other horses. They possess, in many sections of the country, a surpassing degree of speed and power of endurance, the result, in part, of the altered condition of things, and greatly, also, of more attention to breeding and training.

The first horses taken from Europe to the western continent, were brought over by Columbus in his second voyage, in 1493, and the first introduced into any part of the territory now comprised within the United States, were brought over and landed in Florida by Cabeça de Vaca, in 1527. These numbered forty-two, but all perished for some cause or other soon after their arrival. The horses found wild on the plains of Texas and the western prairies are, probably, descendants of the fine Spanish horses abandoned by De Soto on the failure of his expedition and the return of his disheartened adventurers. In 1604, a French lawyer, M. L'Escarbot, brought over horses to Acadia, and from there the French, who extended their settlements into Canada in 1608, took the horses which, probably, laid the foundation of what are now known as Canadian ponies, having, no doubt, lost much of their original size by the severity of the climate and limited summer forage. Though degenerated in size, they still show traces of Norman blood, from which they probably sprang.

In 1609 six mares and a horse were taken to the settlement at Jamestown, in Virginia, and in 1657 the exportation of horses from that colony was strictly prohibited. In 1629-30 horses were introduced into the colony of the Massachusetts Bay by Higginson. These were brought from Leicestershire, in England. The Dutch West India Company had imported horses from Flanders, probably, into New York, in 1625, and it is thought by some that the Conestogas derive their origin from this source. The French, who settled in Illinois in 1682, had many Canadian horses, which were allowed to run on the extensive "ranges" in their vicinity.

Thus we see, in part, the varied sources from which the native horses of this country came. To these were added, from time to time, in the middle and southern states, more or less of thorough-bred, or racing stock, which essentially modified the stock with which it became mixed. The horses of New England, especially of Vermont and Massachusetts, have been used chiefly as roadsters and for general utility. They possess the most admirable qualities of power, speed, and endurance, and, for quick work and travel on the road, they are unsurpassed by any horses in the world. Low, in his "History of Domestic Animals," says of the people of this country: "They prefer the trot to the paces more admired in the old continent, and, having directed attention to the conformation which consists with this character, the fastest trotting horses in the world are to be found in the United States."

Among the changes which have been effected within the last eighty years in the horses of New England, on which the high encomium given by Prof. Low is chiefly based, none, certainly, have been more marked than the increase of speed. Fast trotting was scarcely known in the time of the old "Justin Morgan," nor was the speed of the horse considered of any special money value till the invention of the modern light buggy and the improvement of the roads, already alluded to. This quality has now become essential to the convenience and comfort of nearly all classes of society. Most people want a horse to go off easily at the rate of eight, ten, or twelve miles an hour, and the horses that do it are now very common, whereas formerly, they were only the very rare exception to the general rate of speed. A demand very soon creates a supply, and the farmer who breeds horses knows his own interest well enough to study the tastes of the community, and to breed accordingly. In point of speed, therefore, there can be no question that a very great increase has been attained by careful breeding, particularly within the last twenty years. In other points some improvement has been made, such as general good qualities of style, action, temper, form, constitution, and endurance. The aggregate money value has been greatly increased, because the number of fast horses and the general average of intrinsic good qualities in horses has been increased, and these command their value. But, perhaps, the tendency has been to congregate the best horses in the cities and large towns, and to draw them from the country. Few farmers want to keep a horse for farm and general purposes, that will bring from two or three to five hundred dollars.



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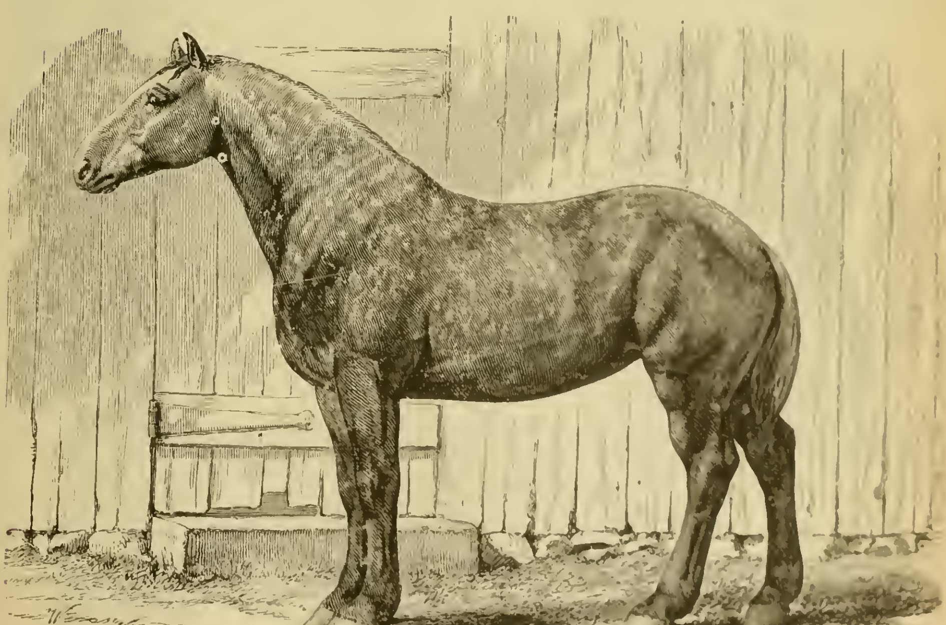

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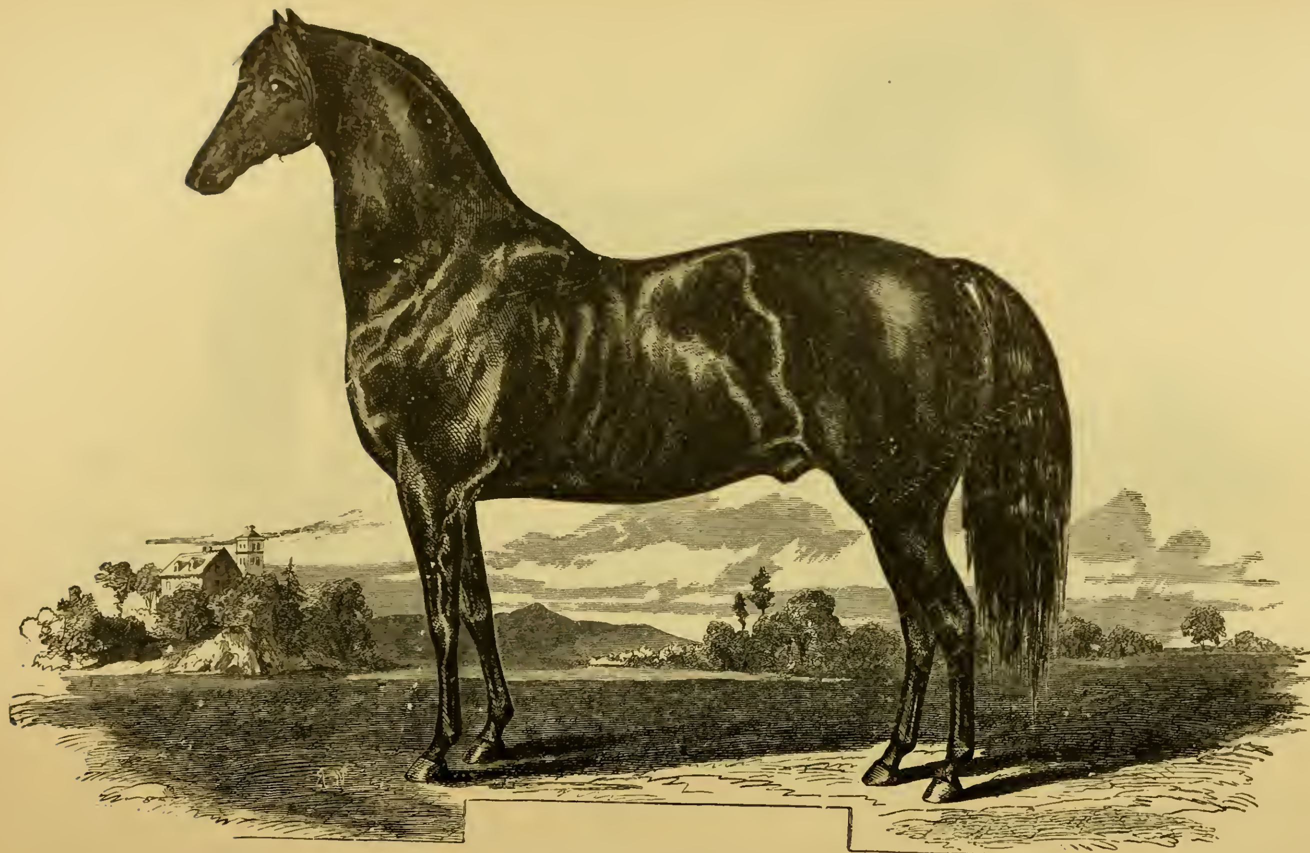
CLYDESDALE HORSES.



PETERSHAM MORGAN.

TROTTING CHILDERS.

Two distinct varieties of horses are now, and have for the last few years been favorites for the road. Neither of these can have any pretensions to the claim of being a distinct race, though they have both become distinct families, well known under their respective names. The peculiarities of both are so well marked, as not to deceive the practised eye. Of these, the Morgan has been alluded to, as deriving its name from the owner of the founder of the family, or the old "Justin Morgan," foaled in West Springfield, Mass., in 1793. The sire of this remarkable stallion is supposed to have been "True Briton," a half thorough-bred. The old "Justin Morgan" soon went to Vermont, 1795, and there laid the foundation of the Morgans of that state, producing the celebrated "Bulrush," "Woodbury," and "Sherman" Morgans, all of which added vastly to the wealth of the breeders and farmers of that section. The descendants of these horses have been spread far and wide. The "Justin Morgan" was a small horse, only about fourteen hands high, and weighing only about nine hundred and fifty pounds. The Morgan horse of the present day is of somewhat larger size, and usually varies from nine hundred and fifty to ten hundred and fifty pounds. He is remarkable for compactness of form, strength, and docility; and for the infinite variety of purposes for which the New England horses are wanted, is probably unsurpassed. He is much sought after for use on the road, and in omnibuses, hacks, and lighter carriages.

The other family, also widely known, not only in New England, but throughout the country, is the Black Hawk. The founder of this family was a horse of that name, celebrated for transmitting his qualities to his offspring, as well as for his great speed as a trotter. He was kept in Vermont till his death in 1856, at the age of twenty-three years. As roadsters, the Black Hawks are often very excellent, possessing a high and nervous style of action, an elastic step, and a symmetrical and muscular form. It is not too much to say that those two classes of horses have added many millions of dollars to the value of the horses of this country. They infused a new spirit into the business of breeding in New England, and had an effect on the enterprise of the farming community, similar to that which the introduction of short-horns had on the general improvement of the stock of the western states.

The style of horse which has been most imported and bred in the southern states, especially in Maryland and Virginia, is quite different. The cavaliers cultivated and encouraged the sports of the turf, and the thorough-bred was early introduced, and bred with much enterprise. Good saddle horses, which in New England are comparatively rare, are very common at the south, where the manly and healthful exercise of horseback-riding has for a long time been almost universally practised, both as a pastime and a common mode of travelling. The interest in breeding thorough-bred horses has been kept up in Kentucky, also, and some of the most renowned running horses of this country hail from that state.

There is a difference of opinion among good judges of horses, as to whether the cross of the thorough-bred horse on the common horse of the country would effect any improvement when viewed from the stand-point of general utility. For special purposes, as for the production of good saddle horses, the value of this cross would, no doubt, be conceded. But the gait most highly prized and most desirable for general utility is the trot, and the mechanical structure best adapted to trotting and running is quite different. At the same time it must be admitted, I think, that some of our best trotters have had strong infusions of thorough-bred blood. Some say, however, that the form of the thorough-bred has been changed, and so far as compactness, muscle, and endurance are concerned, degenerated. This is an opinion merely, which would apply with greater force to the general average of thorough-breds or racers in England than in this country. The experiment is undergoing full and fair trial throughout the Northern States at the present time.

The Conestoga is a large and very heavy breed of horses, often met with in the middle states, and used mostly for the purposes of slow draught in the drays of our large towns and cities. The breed, originally Norman, has been greatly improved by the importation of the finest Percheron Norman stallions and mares. The large draught horses in our cities are now some of the finest in the world.

Both the quality and number of American horses have greatly advanced in the past eighty years. The number of horses in 1850, exclusive of those of large cities and towns, was 4,336,719.

The number of horses, mules, and asses, in 1840, was 4,335,669, while the aggregate number of these classes in 1850 was 4,896,-050, that of mules and asses being 559,331. The number of horses in the United States in 1860, including those in cities and towns, was 7,434,688, and excluding these, as in 1840 and 1850, 6,249,174. The number of asses and mules was 1,317,934, or excluding those in cities and towns, 1,151,148. The war made sad hovoc with these animals, many being killed on the battle-fields, or by overwork, exposure and malignant epidemics. In 1870, the number of horses was 7,145,370, their average value was $84.16, and their aggregatevalue $607,354-,339. The same year the number of mules and asses was 1,125,415; their average value $106.74, and their aggregate value $120,126,797. In 1880 the Agricultural Department estimated the number of horses at 11,201,800. The average price was estimated to be $54.75, and the aggregate value $613,296,611. The number of mules was 1,729,500, average price $61.26, and aggregate value $105,948,319.

### SHEEP.

Another branch of farming which has been subject to more or less vicissitude, is that of sheep husbandry. The first sheep imported into this country were, probably, those taken into Virginia in 1609. They came from England, and thrived so well that in 1648 they had increased to three thousand.

About the year 1625, some sheep were introduced into New York by the Dutch West India Company. These came from Holland, and, together with others which arrived in 1630, proved to be too much of a temptation to dogs and wolves, for it is stated that in 1643 there were not more than sixteen sheep in the whole colony.

Sheep were brought into the Plymouth colony, and that of the Massachusetts Bay, very soon after the settlement. They were kept on the islands in Boston harbor as early as 1633, and in 1635 the number of sheep in the New Hampshire settlement, near Portsmouth, was ninety-two. In 1652 the number of sheep in and around Boston had largely increased, since there were four hundred in Charlestown. In 1660 they were introduced upon the island of Nantucket, and the raising of wool grew up to be of some importance there.

Sheep husbandry, in the earlier history of the country, was carried on very differently, for the most part, from what it has been more recently. There were few extensive flocks, but in the days of homespun it was very common for the farmer to keep a number sufficient for home consumption. In fact, it was almost a matter of necessity. But the old native sheep was a coarse, long-legged, and unprofitable animal. The first fine-woolled sheep introduced into the country were those brought from Spain by Mr. Wm. Foster, of Boston, in 1793. He speaks of them as follows:—

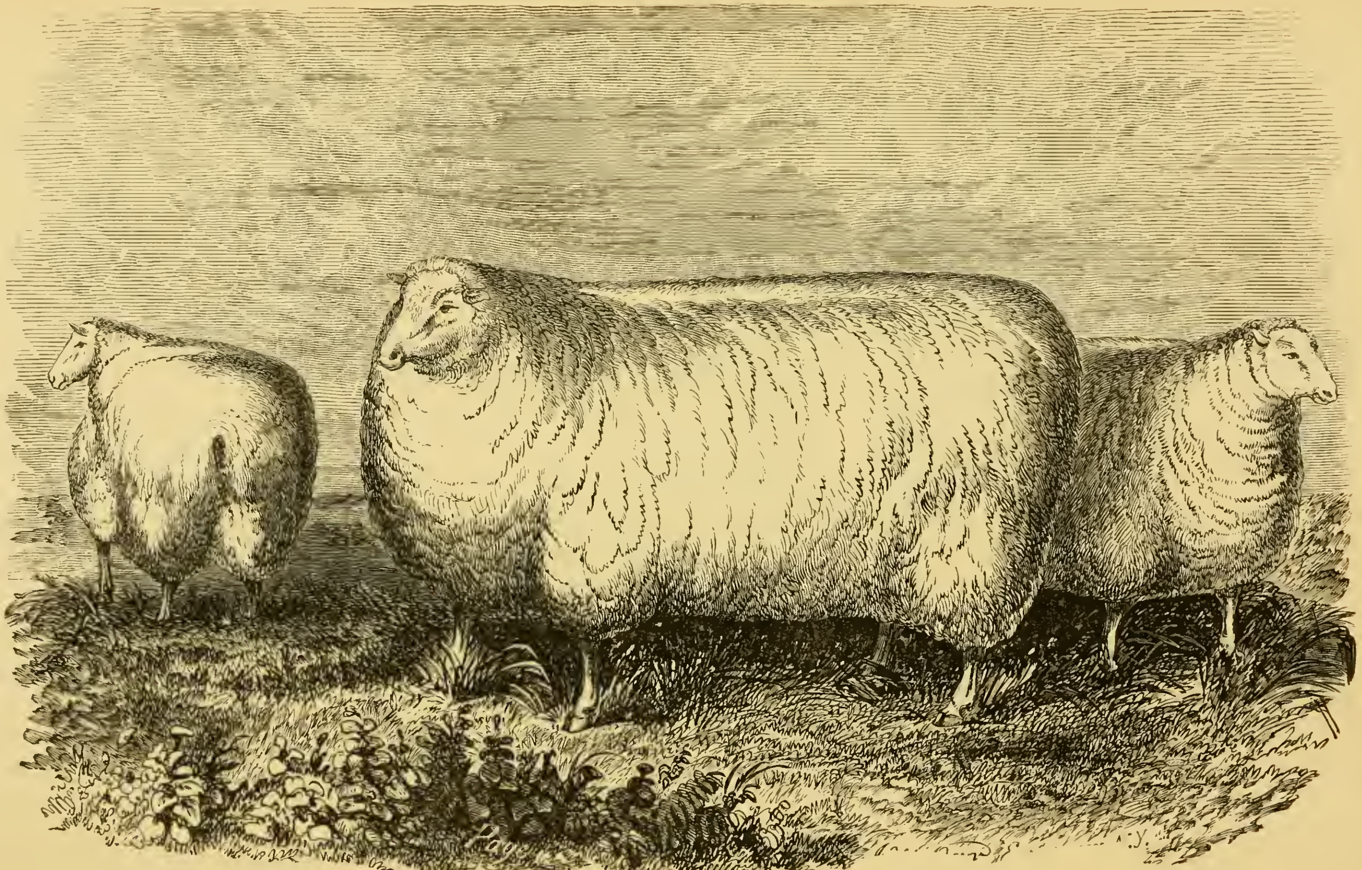
"In April, 1793, on returning from Cadiz, where I had been passing several years, I brought out an original painting, by Murillo, and three merino sheep—two ewes and a ram—the export of which, at that time, was severely prohibited, and attended with much difficulty and risk. We had a long passage—seventy-five days—and the sheep were in a dying condition. Fortunately, there was on board a Frenchman, that had been with the Spanish shepherds, who cured them by administering injections. Being about to leave this country for France, soon after my arrival in Boston, I presented these sheep to Mr. Andrew Craigie, of Cambridge, who, not knowing their value at that time, 'simply ate them,' as he told me years after, when I met him at an auction, buying a merino ram for $1,000."

Another small importation of merinos was made in 1802, and again in 1809 or 1810, about which time a complete merino fever ran through the whole farming community, which had its day, and then subsided.

The embargo of 1808 led many to turn their attention to wool growing, and fine wool soon rose to the high price of $1.50 and $2.00 a pound. In 1809-10, no less than 3,650 merinos were imported and distributed throughout the United States. The importance of these early importations can hardly be overestimated. They furnished our woollen manufactories with the raw material at a time when it would have been extremely difficult to obtain it from abroad.

In the ten years from 1840 to 1850, the sheep of the United States increased two and a half millions, and numbered about twenty-two millions, or more accurately, 21,723,220. But in New England there was a remarkable falling off from 3,811,307 in 1840, to 2,164,452 in 1850, making a loss of forty-five per cent., while in the five sea-board

COTSWOLD SHEEP.



IMPROVED KENTUCKY SOUTH DOWNS.

states of New York, New Jersey, Pennsylvania, Delaware and Maryland, the decrease was twenty-two per cent. The increase was chiefly in the southern and western states. The production of wool steadily increased, for in 1840 we raised 35,802,114 pounds, valued at $11,345,318; in 1850 we raised 52,516,959 pounds, worth $15,755,088; and in 1855 we raised 61,560,379 pounds, worth $23,392,944, being a gain of forty-six per cent. But as some evidence of improvement, it may be stated that the average weight of fleece increased from 1.84 pounds in 1840, to 2.43 in 1850. In 1860, the number of sheep had increased to 23,977,-085, a gain of about 2,200,000. There was again a heavy falling off in the New England states, which had only 1,880,767, about 367,000 less than in 1850. The Middle States had 4,629,285, a loss of a little more than a million. The South had 5,674,000, a gain of a little more than 1,100,000, of which fully nine-tenths was in Texas. The west, including the territories, had 11,750,877, an increase of nearly 2,250,000; mainly in California, New Mexico, Michigan, Missouri, and Minnesota. The amount of wool produced in 1860 was 60,264,913 pounds, about 1,300,000 pounds less than in 1855, though the price being a little higher, it brought about the same amount. In 1870 the number of sheep was 28,477,951, a gain of 4,510,866 over the previous decade. New England had 1,450,145, a loss of 430,622 since 1860. The Middle States had 9,024,-581, or almost double the number in 1860. The Southern States reported 6,693,715, an increase of 1,019,715. The Western States and Territories reported 11,239,390, or 511,487 less than in 1860, the war having drawn very heavily upon the flocks in the West and the great resources of California, New Mexico, and Colorado being as yet undeveloped. The greatest increase had been in the Middle States. In 1880. the west had become the best region for sheep farming. The estimated number of sheep in the whole country was 48,765,900, of which New England had 1,725,600. an increase of 275,455 over 1870; the Middle States 8,062,900, a falling off of about a million from 1870; the Southern States had 13,493,800, an increase of 6,800,000, much of it in Texas; the Western States reported 27,546.400, of which New Mexico had nearly 10,000,000 and California 7,646,800. This was an advance of more than 16 millions on the number in 1870. Sheep farming is a profitable pursuit, especially in the Western States and territories. Growing mutton and lamb for the market at even the present moderate prices of those articles in the eastern markets, is not an unprofitable branch of farming; the early spring lambs, especially, bringing a good remuneration to the grower. The great supply of mutton for the eastern markets comes from the prairie states, where it can be grown much cheaper than is possible on the Atlantic coast.

In the meantime the capacities and adaptation of the climates of the south and west for raising wool are being more and more appreciated, and those sections are growing more wool. It has been shown by the experience of the last ten years, that by proper attention to breeding, the hilly portions even of the extreme south may be profitably devoted to the production of wool. At the World's Fair, at London, in 1851, the fleece that commanded the highest premium for the fineness and beauty of staple, was grown in Tennessee. Germany, Spain, Saxony, and Silesia were there in strong and honorable competition. "Nature," says the owner of the premium fleece, "gave me the advantage in climate, but the noble lords and wealthy princes of Europe did not know it, neither did my own countrymen know it, until we met in the Crystal Palace of London, before a million of spectators. While their flocks were housed six months in the year, to shelter them from the snow of a high latitude, and were fed from the granaries and stock-yards, mine were roaming over the green pastures of Tennessee, warmed by the genial influence of a summer sun; the fleece thus softened and rendered oily by the warmth and green food, producing a fine, even fibre."

The American Commissioner of the Paris Exhibition of 1867, states that our woolen manufactures, in the quality of the wool, and in efficiency of system, processes and machinery of fabrication, are on an equality with the most advanced nations. The total product of wool in the United States in 1867, was one hundred fifteen million pounds, a little more than double that of 1850, and fifty-five million pounds more than the yield of 1860. The import of wool the previous year (1866,) had been 67,917,031 pounds, but the tariff of 1867 raising the duty on foreign wool, the importation dropped at once to 36,318,299 pounds. The export of wool the same year was 307,418 pounds. The value of the imported wool was $5,915,-178, and of the exported $130,857, leaving a balance against us of $5,784,321. The imports of woolen manufactures the same year amounted to $45,813,212, and on exports of woolen goods of our own manufacture were less than $100,000. The consumption of raw wool for the years 1862, 1863, 1864, 1865, and 1866, averaged one hundred and ninety-seven million pounds per annum. It increased to 211 million pounds in the four years, 1867–70. In 1860 the census reported 60,264,913 pounds of wool produced. According to the census, there were 6,578,064 pounds of wool produced in New England in 1860, a falling off of 500,000 pounds from 1850. In the Middle States (N. Y., N. J., Pa., and Ohio,) the production of 1860 was 25,165,173 pounds, an increase of almost ten million pounds; the Southern States reported in 1860 14,-807,960 pounds, an advance of about 6,-500,000 pounds. The Western States produced in 1860, 13,713,680 pounds.

In 1870 the total production of wool, according to the census was 100,102,387 pounds; according to Nimmo's abstract 162,000,000 pounds; the latter is likely to be nearest right, but in the detail of States we must follow the census. New England produced, according to the ninth census, 6,643,863 pounds; the Middle States, 38,-037,299, nearly 13 million pounds advance on 1860; the Southern States, 14,251,352, a slight falling off from1860; the Western States and territories, 41,832,040, an advance of 28,000,000 over 1860.

In 1880 the total production according to Nimmo's tables was 232,500,000 pounds, an increase of 70,500,000 pounds. We have not yet the details from all the States, but enough is known to make it certain that a large portion of this increase is in States and territories lying west of the Mississippi river. The States of California and Texas, and the territory of New Mexico alone yielded in that year not less than 75,000,000 pounds of wool, and these and other States will continue to increase their production till we shall no longer import wool, but shall largely export it.

### SWINE, AND THE PORK BUSINESS.

Few animals are so susceptible of change and improvement in the hands of the skillful breeder as the hog. This animal comes to maturity in so much less time than the horse or the cow, and increases with so much greater rapidity, as to offer larger inducements to improve and perfect it.

Ferdinand de Soto probably brought the first swine into this country, in 1538. These came from Cuba, and were landed in Florida. They were probably descended from some brought over by Columbus in 1493. The Portuguese, it is well known, brought swine into Nova Scotia and Newfoundland as early as 1553, where they rapidly multiplied.

The London Company imported swine into Virginia in 1609. They increased so fast, that in 1627 the colony was in danger of being overrun with them, while the Indians fed on pork from the hogs that had become wild from running at large in the woods.

Meantime, they were introduced into the Plymouth colony in 1624, by Gov. Winslow, and into New Netherlands—now New York —in 1625, by the Dutch West India Company. In all the colonies, as well as in the French settlements in Illinois, they were allowed to run at large with considerable freedom, and fed on mast, though it was soon found that pork fed on Indian corn was much sweeter than that mast-fed.

It is not probable that any special attention was paid to breeding, with reference to improving this animal, till near the close of the last century. The first improvements effected that excited any considerable interest, seem to have been produced by a pair of pigs sent from Woburn Abbey by the Duke of Bedford to General Washington. Parkinson, the Englishman to whom they were entrusted for delivery to the general, was dishonest enough to sell them on his arrival in this country. They were long known as the Woburn, and, in some sections, as the Bedford hog, and were originated by a fortunate cross of the Chinese and the large English hog. There is no doubt they were splendid animals, with many fine points, small bones, deep, round barrel, short legs, feeding easily, and maturing early, and often weighing at a year or a year and a half old, from four to seven hundred pounds, with light offal, and the first quality of flesh. They were mostly white—somewhat spotted. They were very common at one time in Maryland, Delaware, and Virginia, and were bred somewhat extensively by Gen. Ridgeley, of Hampton—a fine country seat in Baltimore county, Md.—who sent a pair of them to Col. Timothy Pickering, of Hamilton, Mass., who bred them till they became quite noted over a wide extent of country. They are now extinct. It is worthy of remark that the Byfield breed originated in the same way, by a cross of the Chinese and the common nog, bred by Gorham Parsons, in Byfield, Mass. This breed became famous, and was very much sought after for many years, and is even now found in Ohio.

Previous to the introduction of the Woburn hog, the classes of swine that had prevailed in the eastern and middle states were coarse, long-legged, large-boned, slab-sided, and flab-eared, an unprofitable and an unsightly beast, better calculated for subsoiling than for filling a pork barrel. An effort had been made to improve them, about fifty years ago, and before the valuable breeds above alluded to had become generally known, by the introduction of an animal commonly called, at that time, the grass-fed hog, which appeared about the time of the introduction of merino sheep, and were often sneered at as the "merino hog." Chancellor Livingston took very great pains to disseminate them, if, indeed, he did not originally import them. They are said to have been an exceedingly well-formed beast, with small heads, round bodies, compact and well made, legs short and small-boned, spotted in color, with a kind of dusky white on a black ground. As they were looked upon as an innovation, they had to encounter the force of public sentiment, but their intrinsic good qualities finally prevailed, and they became popular.

Since that period the introduction of many varieties of superior hogs, both from Europe and Asia, has effected a very marked improvement in the common hog of the present day, though it has been a too frequent practice to breed indiscriminately. A pure breed, like the Suffolk, the Berkshire, or the Essex, may be used to cross for a specific purpose, but the pure breed ought again and constantly to be resorted to, or the result will be likely to be unsatisfactory. It requires great skill and judgment to breed judiciously, and it ought to be made a special branch of farming to a greater extent than it usually is, in order to insure the preservation and perpetuation of purity of blood.

It is well settled that neither the eastern nor the middle states can compete successfully with the west in the raising of swine and the production of pork on a large scale. The cost of grain in those sections of the country would prevent it. A limited number of hogs can be kept to advantage in a section of small farms, sufficient to consume and thus economize the refuse of the dairy and other farm products, that would otherwise be liable to waste, but beyond this, the keeping of swine is not only not profitable, but an absolute bill of expense.

In Missouri, Iowa, Kansas, Nebraska, Illinois, Indiana, and other States where corn is raised with little labor, and in large quantities, the cost of pork is small compared with the keeping of swine in the eastern states. The raising and packing of pork has, therefore, very naturally grown up in the western states, and vast quantities are exported from there every year, including pigs on foot, by railway, slaughtered and sent off in the whole carcass, and in hams, shoulders, and sides, smoked, and in the shape of barrelled pickled pork.

The native hogs of the west—that is, the descendants of those taken there by the earlier settlers, and common there till within a very recent period—were admirably calculated for the primitive condition of civilization in which they were placed. They were well calculated to shirk for themselves, as they had to do, and became as fleet as the deer, while their strength of head, neck, and tusks enabled them to fight any wild beast of the forest, and withstand any extent of exposure to the weather. They were diametrically opposite in every prominent good quality to the improved swine of the present day. Instead of speed and fleetness of foot, the farmer wants sluggishness in his hogs; instead of coarse, rawny bones, he wants fine, small-boned animals; and instead of a thick, hard coat, he wants a fine head, thin coat, ready fattening qualities, and general thriftiness. And so the Suffolks became the favorites, and produced many most excellent crosses with the old natives. In other parts of Ohio, where improvement has taken place, the Byfield, the Chester County, the Berkshire, the China, the Irish Grazier, or some other of the many excellent improved breeds have been introduced, and effected a great and perceptible change. The western farmer wants greater size than he finds in the pure Suffolk or the pure bred Essex, and he finds the Poland China, the Chester

White. and some of the improved Berkshires, the best breeds for his use. In Kansas and Iowa the breeding of swine has been reduced more nearly to an exact science than elsewhere, and in spite of all losses, it is found profitable when Indian corn or its equivalent can be bought for 20c. a bushel. From 1840 to 1860 the number of swine in the U. S. largely exceeded the number of sheep; in 1850 there were 30,354,213 swine to 21,723,220 sheep; 1860, 33,512,867 swine to 22,471,275 sheep. During the war, and after it the proportions were reversed; in 1870 there were 25,134,569 swine to 28,477,951 sheep; in 1880, 34,034,100 swine to 48,765,900 sheep. Although there has been, as will be noticed, an advance of nearly 9,000,000 in the number of swine in the last decade, this increase would have been more than doubled if the swine plague, popularly known as "hog cholera," and other fatal diseases of swine had not been so prevalent. The investigations of the U. S. Agricultural Department will result in removing many of the remote causes of this dreaded disease, and in stamping it out where it appears. From 1850 to 1860, Indiana took the lead in the raising of swine, having in the latter year 3,099,110, though Kentucky had led in 1850 with 2,891,863. In 1860 Illinois was next to Indiana, followed by Missouri and Tennessee, and Kentucky held the 5th place. In 1870 the order was changed, Illinois taking the lead with 2,703,343, Missouri came next with 2,306,430, and Indiana took the 3d place with 1,872,230, followed closely by Kentucky, Tennessee, and Ohio. In 1880 Illinois still leads with 3,202,600, but Iowa has reached the second place with 2,778,400, Missouri has the third place with 2,620,400, and Indiana has dropped to the fourth place with 2,186,000, while Ohio stands fifth, Texas sixth, Kentucky seventh, and Tennessee eighth. In one or two years more Kansas, now 12th in order, will have risen to the third place—so rapid has been the development of this industry in that State, and so thorough its organization. The value of the living swine at the end of 1879 was estimated at $145,781,515, and in the year ending June 30, 1880, $85,000,000 of hog products were exported.

Pork-packing has been for the last thirty-five years a very large and constantly increasing business in the west. Cincinnati long took the lead in this enterprise, packing, in favorable years, nearly 500,000 hogs in a single season. St. Louis and Chicago both became rivals for this trade as early as 1857 or 1858, but in 1862, Chicago at one bound distanced Cincinnati and St. Louis, and taking the lead has kept it ever since, packing in 1879–80 nearly five million hogs. It is now much the largest pork market in the world. A description of one of the great packing establishments may be interesting, though they differ in some of the details. The hogs are drawn up an incline to the top of the building where they have pure air and good ventilation, and are kept quiet two nights and a day before being killed. When all is ready the hogs are driven, some twenty at once, into a small pen with a fine grated floor. A man then enters, and, with a long handled hammer, deals each hog a heavy blow on the forehead between the eyes, which instantly drops him on the floor. After he has lain a few moments, another man enters the pen with a sharp knife and sticks each hog, the blood flowing through the floor, and being conducted by spouts to large tanks outside the building. While this is being done another lot is let into an adjoining pen and served in the same manner. The first lot, by this time, having bled sufficiently, is slid down an inclined plane directly into the scalding tub or vat, made of wood, some six feet wide, twenty feet long, and three feet deep, the water in which is heated by steam-pipes, and kept at a regular temperature; here they are floated along and turned by men at the sides until they reach the further end, where they are taken out of the tub by a simple contrivance, operated by a single man, and deposited upon the end of a long inclined table. Two men stand ready and take from the back in an instant all the bristles that are suitable for the brush-maker and cobbler, depositing them in boxes or barrels for removal. Other pairs of men, standing on opposite sides of the table, divest another part of the hog of its coat and so on through some eight or ten pairs of men, who each have a different part to perform in cleaning the hog, until it reaches the last pair, who put in the gambrel stick and swing it on a hook on an overhead railway, there it receives a shower bath of clean cold water, washing it clean from any particles of dirt that may remain, giving it, at the same time, a parting scrape with knives. It then passes along to a man who opens it and removes the large intestines. It then passes to the second man, who takes out the small intestines, heart, lights, &c.; the hog then receives a thorough drench of clean water, and passes to another man who splits the backbone down. They are then taken from the hooks and borne away by overhead roadways, and hung up to cool, one man being enough to handle the largest hogs with ease. At this point a man loosens up the leaf lard ready to be removed when cooled, which, together with the splitting of the backbone before mentioned, helps very much to thoroughly cool the meat. The hogs are allowed to hang in this cooling-room, before being cut up, two days, when all animal heat is gone.

After the small intestines, &c., are removed from the hog, they are taken by men and boys, and all the fat separated from them and placed in large vats of water to wash it clean, going through two waters, when it is ready to go into the lard tank, which will be described hereafter.

Having now got the hog ready for cutting up, he is taken from the cooling-room and carried to the room for this purpose, each hog being weighed as he is brought up, and its weight entered in a book kept for that purpose. Having been rolled on to the block, one blow from an immense cleaver severs the head from the body; another blow severs the saddle, that is, the hind parts, containing the hams; another lays it open at the back; another one for each leg; the leaf lard having already been loosened is now taken hold of with the hands, and instantly stripped out of the carcass. The remainder of the hog is then cut up according to the kind of meat it is most suitable for, the whole cutting-up process occupying but a few seconds of time, two smart men having cut over two thousand in less than eight hours. The usual day's work, however, is from 1,100 to 1,200 head.

The lard-house is 35 by 156 feet and three stories high. In the second story are arranged seven iron tanks, made of heavy boiler iron, twelve feet high, and six feet in diameter, capable of sustaining a high pressure. These extend up through the floor above into the third story, where each one is provided with a large man-hole into which the leaf lard, head, gut lard, and pork trimmings are emptied, until the tank is full, when it is closed and the whole mass subjected to a jet of steam from the boilers, of a pressure of fifteen pounds per inch; each tank is supplied with a safety valve, so that on reaching the maximum pressure allowed, it passes off, causing a continuous flow of steam through the whole mass. By this process every particle of lard is set free from the mass.

One of the tanks is reserved for making *white grease*, into which the intestines, paunches, and all refuse from the slaughter house are placed, and subjected to the same steam process.

Another tank is used for trying out dead hogs that are killed by accident, suffocation, &c., into which they are dumped whole, with the "pizzles" from the slaughter house. The product of this is called *yellow grease*.

After the mass in the lard tanks has had steam on the necessary length of time, a faucet is opened midway of the tank, or about where the lard and water would meet, and the lard drawn off into an immense open iron tank, called a clarifier, with a concave bottom, provided with a steam-jacket on the bottom; here it is heated up to 300° F., sending all foul matters in a thick scum at the top, when it is skimmed off, all heavy matters of dirt, &c., settling on the bottom, this process thoroughly clarifying the lard. A faucet is then opened at the bottom, and the sediment allowed to run out until clear lard appears, when it is shut off, and the balance drawn into the coolers, thence into barrels, where it is weighed and branded pure lard, and the product is the purest article we have ever seen manufactured by any process, it being perfectly free from any unpleasant odor, and as pleasant to taste as new unsalted butter.

After the lard has been drawn from the tanks a large man-hole is opened at the bottom, and the whole mass is drawn out in large wooden tanks set even with the floor. Here the mass is again subjected to a boiling heat, by steam-pipes laid around the inside; any remaining grease is thus set free, and rises to the top and is skimmed off. A plug is drawn and the water disappears into the sewer. A gate is opened at the side, and the mass is turned out doors, ready to be carried off. Here you will find every bone that entered the tank whole and sound a bleached mass, so soft that even the teeth of the hog may be easily mashed between the fingers. The bristles and hair are readily purchased by those who prepare hair for mattresses, "finding" dealers, &c.

*The Curing room.* This occupies the

lower floor. The first process is to dress all the meats, except the shoulders, with a solution of saltpetre, which is applied with a swab to the green meat, and while wet with it is covered and rubbed with salt, and then packed in tiers to cure. In three weeks it is all handled over and treated to a second dressing of salt, and again in seven days more, when it is pronounced cured. After lying a few days, the English meats are taken and carefully scraped and smoothed off preparatory to packing. These meats are usually packed in square boxes containing 500 pounds.

The barrel meat is packed in the second story. Enough pieces of the various kinds are weighed out for a barrel, (200 pounds.) It is then packed in the barrels, a layer of meat, then salt, until filled, the whole headed up and branded. Each barrel is then filled with as much brine as the barrel will take, and allowed to stand with a small bung open a short time.

*Description of meats.* Mess pork is made of the sides of the thickest and fattest hogs, cut in strips six to seven inches wide, running from back to belly.

Mess O. pork (mess ordinary) is cut from the sides of a lighter class of hogs, ranging from 170 to 200 pounds, cut up in the same manner.

Prime mess is cut from a still lighter class, ranging from 100 to 150 pounds weight, the shoulder being included. While on the block this class, after being divested of the head, saddle, and lard, is cut lengthwise about mid-way of the ribs, and then cut up cross-ways into 4 pound pieces, so that it takes just fifty of them to make a barrel.

The hams and shoulders are taken by the trimmers—the hams nicely rounded off and shaped; the shoulders the same—when they are dropped through a spout to the lower floor, as is all the other meat cut for curing. The heads, trimmings, leaf lard, gut lard, &c., are all gathered and taken to the lard-house.

The feet generally go to the glue makers. Quantities, however, are prepared for eating by thoroughly cleaning and freeing from the toe nails; then thoroughly cooking and pickling in vinegar.

The tongues are packed in barrels, the same as mess pork, and always in demand, large quantities finding a foreign market. For home consumption they are prepared and pickled the same as the feet.

*Lard oil* is made by placing the lard in heavy duck bagging, and subjecting it to powerful pressure, the residuum being stearine, which is extensively manufactured into candles of excellent quality.

The quality of smoked meat depends very much upon the curing of it previous to smoking.

The process of curing varies with different houses, some applying the saltpetre and salt, and packing in bulk to cure; while others prepare a pickle (sweet pickle generally) by the use of three ounces of saltpetre, and one to two quarts of molasses for a tierce, the brine being made to show thirty degrees of saltness by the meter.

After the meat has lain sufficient time in the pickle, it is taken out and packed in bulk for curing, or, which is better, hung up in the smoke-house, remaining at least four weeks before it is thoroughly cured.

If the meat is designed for shipment to foreign ports, it is seldom smoked, but shipped packed in tierces, with salt, like other barrel meat, and the cask filled with the sweet pickle.

The following table shows the number of hogs packed in Cincinnati, in the designated years, beginning with 1848:

| | | | | | |
|---|---|---|---|---|---|
| 1848 | 475,000 | 1860 | 434 499 | 1873 | 626,306 |
| 1850 | 393,000 | 1863 | 608, [illegible]7 | 1875 | 560,164 |
| 1852 | 352,000 | 1865 | 350,600 | 1877 | 523,572 |
| 1854 | 421,000 | 1867 | 462,600 | 1878 | 632,308 |
| 1856 | 405,396 | 1869 | 356,555 | 1879 | 623,584 |
| 1858 | 446,677 | 1871 | 500,066 | 1880 | 607,895 |

The number packed in Chicago in the years specified below, was,

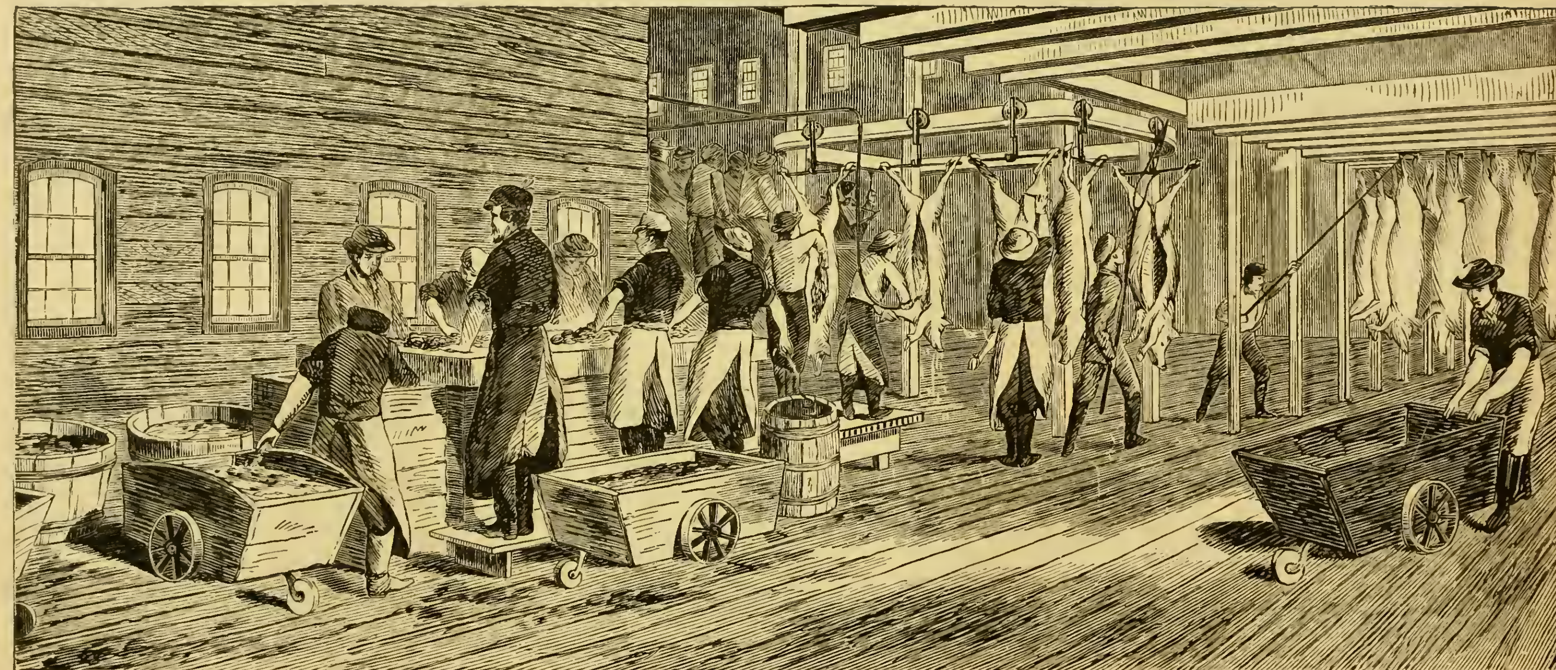
| | | | | | |
|---|---|---|---|---|---|
| 1853-4 | 52.849 | 1864-5 | 760,514 | 1874-5 | 1,781.796 |
| 1855-6 | 80.380 | 1865-6 | 463,450 | 1876-7 | 3.220.621 |
| 1857-8 | 99,262 | 1866-7 | 635,732 | 1877-8 | 4,222.774 |
| 1859-60 | 167,968 | 1867-8 | 800,000 | 1878-9 | 5,232,737 |
| 1861-2 | 511,118 | 1868-9 | 719,000 | 1879-80 | 4,940,172 |
| 1862-3 | 970,264 | 1869-70 | 688,140 | | |

St. Louis, Louisville, Toledo, Dubuque, Cleveland, Terre Haute, and 144 other cities and towns in the western states, are engaged in pork-packing, and the entire number packed range from 5,000,000 to 9,000,000 per annum. The business has steadily increased since 1850, when it first assumed a considerable magnitude, being in 1879 more than seven-fold greater than thirty years before.

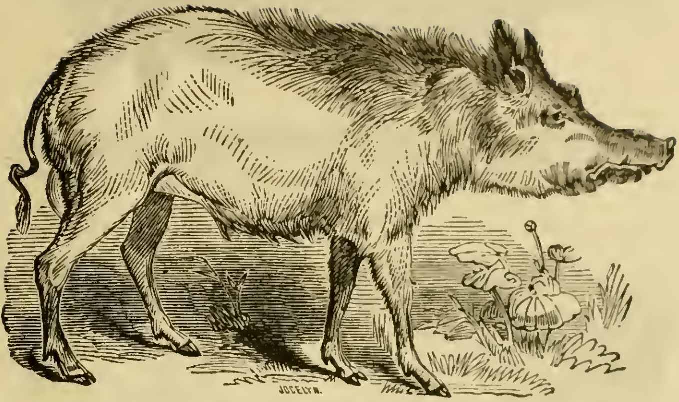
We have thus alluded briefly to the various classes of live stock in the United States, and have given some idea of its progressively increasing value. Let us now recapitulate the aggregate of the census of 1870, and of the estimates of the Agricultural Department for 1880, in such a shape as to show the growth of the country in this branch of agriculture. The statistics of live stock in the United States in 1850, 1870, and 1880

SLAUGHTERING HOGS.

We do not illustrate the process of knocking down and sticking of hogs, supposing it would not produce any pleasing emotions.

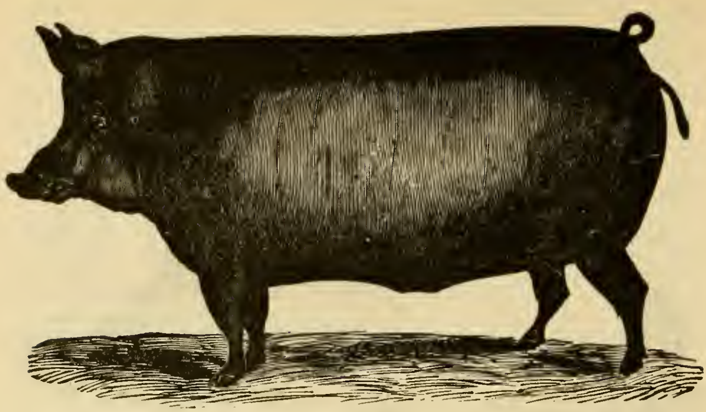


SLAUGHTERING HOGS.

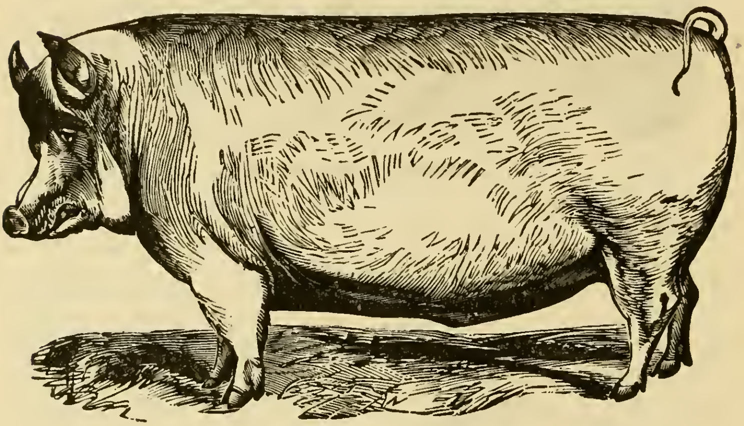


SOUTHERN PINE WOODS HOG.

WESTERN BEECH NUT HOG.



IMPROVED ESSEX.



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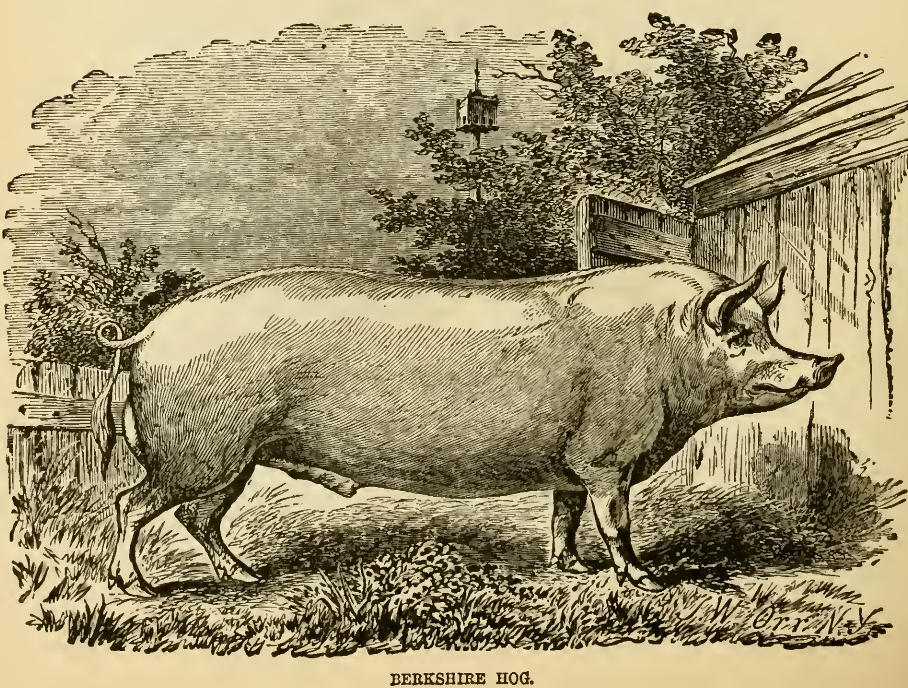



BERKSHIRE HOG.

are as follows, the value at the last date only being given:

| Animals. | No. 1850. | No. 1870. | No. 1880. | Value 1880. |
|---|---|---|---|---|
| Horses. . . . . . | $1,336,719 | $7.145,370 | 11,201,800 | $613,296 611 |
| Asses and Mules. . | 559,331 | 1,317,934 | 1,729,500 | 105,948,319 |
| Milch Cows. . . . | 6,385,094 | 8,935,332 | 12,027,000 | 279,899,420 |
| Working Oxen. . . | 1,700,694 | 1,319,271 | } 21,231,000 | 341,761,154 |
| Other Cattle. . . . | 10,293,069 | 13,566,005 | | |
| Sheep. . . . . . | 21,723,329 | 28.477,951 | 48,765,900 | 107,772,639 |
| Swine. . . . . . | 30,354,213 | 25,134,569 | 34,034,100 | 145,781,515 |
| | | | | $1.594,459,658 |

The advance in numbers of these animals averaged nearly forty per cent., but the valuation in 1870 was a currency valuation, and inflation was at its highest point; the valuation of 1880 was made after resumption, when prices had fallen about 70 per cent., so that the $1.594,459,658 represents an actual intrinsic value equal to $3,000,000,000 at least, in 1870.

The value of slaughtered animals for the year 1870 was $398,956,376. The export demand for American beef, mutton, and provisions which has increased so rapidly within the last decade, and the growing market for meats at home justify us in estimating the value in 1880 at $800,000,000. The value of the farms in 1870 was $9,262,803,861. Notwithstanding the downfall of prices from resumption, this valuation must have increased at least one-third, which would be $12,350,405,148. The farming implements and machinery in 1870 were valued in the census at $336,878,429, but the past decade has been remarkable for the increase of agricultural machinery, and its present value is at least $620,000,000.

Our grand aggregate, then, of agricultural property in 1880, farms, farming machinery, live stock, and slaughtered animals is $15,367.864,806. Let us next inquire what is the annual income of this vast sum invested in farming and labor, and refer to the farm products for a reply.

### PRODUCTS OF THE SOIL.

In a range of latitude extending almost from the tropics to the regions of frost and snow, we should naturally expect to find a great variety of climate, and the products more especially adapted to it. And such is the case. The products of our agriculture are infinitely varied, and all the great staples form a most important part in promoting the national prosperity. But if, among them all, one can be said to hold pre-eminence over the rest, the palm must be yielded to the golden corn, rearing its imperial form and tasselled banner high over all its compeers, and founding its claim to royalty, as the prince of cereals, by the universality of its uses and its intrinsic importance to mankind.

Its flexibility of organization is truly wonderful; for while it grows best on moist, rich soils, and with great heats, there are varieties of it which can be raised at the height of more than eight thousand feet above the level of the sea. The warmest regions of the torrid zone produce it in abundance, while the short summers of Canada have varieties adapted to them which arrive at maturity with almost the same certainty as those under a hotter sun and a longer season.

Indian Corn, therefore, as being the great staple crop of the country, demands our first attention.

This plant is of American origin. It was found in cultivation among the aborigines of the country at the time of its discovery by Columbus. It is referred to by the oldest historians of Peru. It has been found growing wild in various parts of Central America, and Humboldt, who must be regarded as the most eminent authority, says: "It is no longer doubted among botanists that *Maize*, or Turkish corn, is a true American grain, and that the old continent received it from the new."

It is well known that Indian corn entered, in some form or other, into the mythology and the religious ceremonies of the Indians, both of North and South America, long before they were disturbed by the appearance and approach of civilization. Schoolcraft mentions an interesting allegory of the Ojibwas, which has since been clothed with an unusual fascination by the graceful language of Longfellow.

A young man went out into the woods to fast, at the period of life when youth is exchanged for manhood. He built a lodge of boughs in a secluded place, and painted his face of a sombre hue. By day he amused himself in walking about, looking at the various shrubs and wild plants, and at night he lay down in his bower, from which, being open, he could look up into the sky. He sought a gift from the Master of Life, and he hoped it would be something to benefit his race. On the third day he became too weak to leave the lodge, and as he lay gazing upward he saw a spirit come down in the shape of a beautiful young man, dressed in green, and having green plumes on his head, who told

*Asses not enumerated.

him to arise and wrestle with him, as this was the only way in which he could obtain his wishes. He did so, and found his strength renewed by the effort. This visit and the trial of wrestling were repeated for four days, the youth feeling at each trial that, although his bodily strength declined, a moral and supernatural energy was imparted, which promised him the final victory. On the third day his celestial visitor spoke to him. "To-morrow," said he, "will be the seventh day of your fast, and the last time I shall wrestle with you. You will triumph over me and gain your wishes. As soon as you have thrown me down, strip off my clothes and bury me on the spot, in soft, fresh earth. When you have done this, leave me, but come occasionally to visit the place, to keep the weeds from growing. Once or twice cover me with fresh earth." He then departed, but returned the next day, and, as he had predicted, was thrown down. The young man punctually obeyed his instructions in every particular, and soon had the pleasure of seeing the green plumes of his sky visitor shooting up through the ground. He carefully weeded the earth, and kept it fresh and soft, and in due time was gratified at beholding the mature plant, bending with its golden fruit, and gracefully waving its green leaves and yellow tassels in the wind. He then invited his parents to the spot to behold the new plant. "It is Mondamin," replied his father, "it is the spirits' grain." Tradition says they immediately prepared a feast, and invited their friends to partake of it; and that this is the origin of Indian corn.

However this may be, we know that the first attempt by the English to cultivate it within the present limits of the United States, was made on James river, in Virginia, 1608 or 1609. The pilgrims found it in cultivation by the Indians around Plymouth, and immediately began its cultivation, manuring it with alewives As early as 1621, Gov. Winslow visited the Nemasket Indians, at Middleboro', Mass., who fed him on *mazium.*

In 1850 the production of Indian corn was 592,071,104 bushels, a decided advance on the crop of 1840; in 1860 it was 838,792.742 bushels, an increase of almost 40 per cent. on 1850, the crop of 1869 reported in the census of 1870, was much smaller than that of the previous year, amounting to only 760,944,549 bushels; that of 1879, reported in the census of 1880, was 1,773,106,576 bushels, more than double that of 1869. The increase was very large in most of the States, and was particularly great in the Western States. The crop of 1880 was estimated as 1,537,535,900 bushels, 236,000,000 bushels less than that of the preceding year, but perhaps from the advance of price of nearly equal money value.

Among the earlier exports of the country we find frequent mention of the number of bushels of Indian corn, showing that a considerable surplus was produced in many localities a century ago. Thus, the amount exported from South Carolina in 1748 was 39,308 bushels, and in 1754, 16,428 bushels. The amount shipped from Savannah in 1755 was 600 bushels, and in 1770, 13,598 bushels. And so North Carolina exported no less than 61,580 bushels as early as 1753. Virginia for several years previous to the Revolution exported 600,000 bushels a year, and from the port of Norfolk alone, 341,984 bushels in the year 1791; while in 1795 the amount from that port reached 442,075 bushels. At the same time the amount sent from City Point, Virginia, in 1791 was 21,180 bushels, including meal, and in 1795, 33,358 bushels.

The amount shipped from Philadelphia in 1752 was 90,740 bushels, and in 1767 there were exported from there 60,206 bushels. In 1771 it reached 259,441 bushels, and in 1796 it amounted to 179,094 bushels, in addition to 223,064 barrels of Indian meal.

There were 2,510 bushels shipped from Portsmouth, N. H., in 1776; and in 1777, 1,915 bushels; which amount increased in 1778 to 5,306 bushels; while in 1779, the export amounted to 3,097. The export of this grain from the same place was 6,711 bushels in 1780, and 5,587 bushels in 1781.

But previous to the first-mentioned date (1776), this grain was on several occasions imported into Portsmouth, and up the Piscataqua river, to the extent, in 1765, of 6,498 bushels, owing, probably, to a severe drought in the year previous, and the spring of 1765, which seriously affected the corn crop. And again, in 1769 the import to that section amounted to 4,097 bushels, followed in 1770 by 16,587 bushels. During that year there was a "very melancholy dry time," in July and August; a drought of such severity that there was little prospect of corn.

The worms had done much injury in the spring, and a "very uncommon sort of worm, called the canker worm, ate the corn and grass all as they went, above ground, which cut short the crops in many places." And again, in 1772 the pastures all dried up, and there was very little corn, and all kinds of grain suffered very much; so that the amount of corn imported into Portsmouth and vicinity was 4,096 bushels in that year.

But the total amount of Indian corn exported from the colonies in 1770 was 578,349 bushels. In 1791 it amounted to 2,064,936 bushels, including 351,695 bushels of Indian meal. In 1800 the aggregate number of bushels exported was 2,032,435, including 338,108 bushels of meal; while in 1810 the export of this grain was only 140,996 bushels, of which 86,744 bushels were in the form of Indian meal.

The product of Indian corn, as may be gathered from the amount exported, had never reached any thing like the figures which it has attained within the last thirty years. This was not owing merely to the fact that the avenues to the great west were not then opened—though, of course, they have vastly multiplied the market facilities for this and other products—but chiefly to the fact that the real advantages of cultivating this as a staple or reliable crop, were not then appreciated as they are now. Add to this the fact that it was comparatively little used as human food in any part of Europe, and we have a reason sufficient to account for the fact that the product was comparatively small. The inland farmer had no market for it, the cost of transportation of so bulky a product prevented him from teaming it to any great distance, and the local demand was so limited that there was no object in raising much more than was absolutely needed for home consumption.

In the year 1816 the crop of Indian corn was very generally cut off throughout the northern states by frequent and severe frosts, so that as a cultivated crop it fell into disrepute in many sections, and was cultivated less for some years, by individual farmers, till its intrinsic importance as a sure and reliable crop brought it gradually into favor. At the time it was first included in the United States census, in 1840, the aggregate yield of the country was 377,531,875, or nearly four hundred millions bushels. In 1850 it had reached within a fraction of six hundred millions, being returned as 592,071,104, occupying 31,000,000 of acres. The value of this enormous crop was $296,034,552. This was a gain of 57 per cent., or 214,539,229 bushels, while the increase of population during the same period was only 35 per cent. According to the estimate of the secretary of the treasury, the crop of Indian corn in 1855 was between seven and eight hundred millions, or nearly double that of 1840. But this estimate was entirely too low, the crop being the largest and best that year that had ever been raised in the country, and amounting, at least, to 1,000,000,000 bushels, and its value, at a low estimate, was $400,000,000.

We see, therefore, on reference to the census, that this crop formed about three-sixteenths of the whole agricultural product of the country in 1850, and that the proportion of improved land devoted to corn was .333, while the number of bushels to each person in the country was 25.53.*

From the amounts of corn stated above, as raised in 1840 and in 1850, it will be seen that we had a very large surplus over and above what we needed for home consumption; though it must be evident that vast quantities are, and must be required to feed to the large number of cattle and swine, which we have seen are annually prepared for the shambles. It appears from official statistics that the exportation of Indian corn has rapidly increased since 1820, when it amounted to only 607,277 bushels, valued at $261,099, and 131,669 barrels of Indian meal, valued at $345,180, making an aggregate of $616,279. In 1830-1 the number of bushels of corn exported from the country was 571,312, valued at $396,617, and 207,604 barrels of Indian meal, valued at $595,434. In 1840-1 the number of bushels of corn exported was 535,727, valued at $312,954, with 232,284 barrels of meal, worth $682,457.

But in 1845-6 the amount rose to 1,826,068 bushels, valued at $1,186,663; and from that in 1846-7 to 16,326,050 bushels of corn, worth $14,395,212. The next year, 1847-8, it reached nearly six millions of bushels; and in 1848-9 to upward of thirteen millions, valued at $7,966,369.

* France produced in 1826 but 17,280,000 bushels, while in 1847 she produced 33,400,000 bushels—being an increase of nearly 100 per cent. in twenty years. Russia produced 16,000,000 of bushels in 1850.

The exports of Indian corn and meal in different years from 1851 to 1868, were as follows:

| Year. | Bush. of corn. | Value. | Bbls. Ind. Meal. | Value. |
|---|---|---|---|---|
| 1851..... | 3,426.811 | $1,762.549 | 203.622 | $622,866 |
| 1856..... | 10.292.280 | 7,622,565 | 293.607 | 1,175,688 |
| 1860..... | 3,726.786 | 2.399,808 | 289.570 | 912.075 |
| 1862..... | 18.904.898 | 10,387,383 | 253.570 | 778,344 |
| 1866-7... | 14.889,823 | 14,871.092 | 284,281 | 1.555,585 |
| 1870-1... | 9.826.309 | 7.458,997 | 211,811 | 951.830 |
| 1872-3... | 38,541,930 | 23.794,694 | 403.111 | 1,474,827 |
| 1876-7... | 70.860.983 | 41,621,245 | 447,907 | 1,511,152 |
| 1878-9... | 86,296.252 | 40.655.120 | 397,160 | 1,052,231 |
| 1879-80.. | 98,169,877 | 53,298,247 | 350,613 | 981,361 |

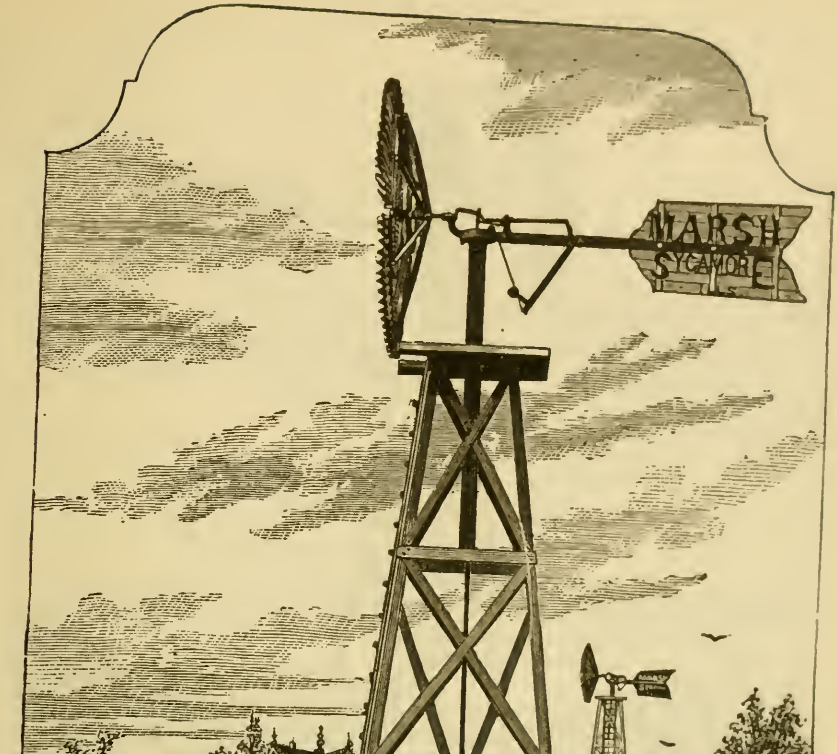
The amount of exports is, of course regulated very much by foreign demand, but is steadily increasing and latterly in a very rapid ratio, as the above table conclusively shows. It is but a few years since the foreign demands for breadstuffs began to any great extent. Now and then would occur a year of unusual scarcity, such as in 1856, 1862, and 1866–7, when our exports ran up to large amounts, reaching in 1862 over 19 millions of dollars, to be sure, but it was rare to find any extensive demand year after year for our surplus products. The increase of population beyond the point of capacity to produce, in Great Britain and the continent of Europe, now gives the bread question an importance paramount to all others with the European statesman, and it is having and will have a powerful influence on our agriculture. Consumption has overtaken production—got beyond it, in fact, in some of the countries of Europe—and henceforth importation must supply an ever increasing demand, since, however much the agricultural production of western Europe may increase by the improving condition of its agriculture, it cannot hereafter keep up with the natural increase of population, which, at the present time, in Great Britain, is at the rate of a thousand per day. This crowding population will appear in its true light, in an agricultural point of view, when it is considered that if the United States and its territories were as thickly populated as Great Britain, they would contain about 1,250,000,000 of people, a number almost equal to the whole population of the globe.

The year 1824, it is asserted by some, was the turning point at which consumption overtook and exceeded production in England. Since that time the agricultural production of Great Britain has been vastly increased by the improvement of agriculture and live stock; but great and perceptible as improvement has been, it has not, and cannot fully supply its overgrown population. The famine in Ireland in 1847, causing the loss of half a million of lives by starvation, and the political revolution which soon followed on the continent in 1848, growing out, to a great extent, of a short supply of food, are fresh in the minds of every one.

Now this surplus of population and the consequent permanent demand for the productions of our soil are of comparatively recent date, and we have hardly, even yet, begun to realize their importance and the influence which they are hereafter to exert in developing the resources of our soil. A century and a quarter ago (1756 M. D'Anqueville, a political economist of France, said: "England could grow corn enough in one year to supply herself for four." Now, though she has, at least, three times as much land under cultivation as then, and though the yield of her products to the acre has been more than doubled, yet she imports food in the shape of corn, wheat, oats, meal, and flour to the extent of more than £55,000,000, or $280,000,000, of which in 1880 more than one-half came from the United States. Russia, Roumania, and Egypt, which had hitherto furnished much of the grain supply of England and France, are now hardly able to supply their home demand, and British statesmen and journals recognize the fact. The *Mark Lane Gazette*, the highest authority on this subject, saying: "One fact is clear, that it is to Western America that we must, in future, look for the largest amount of cereal produce."

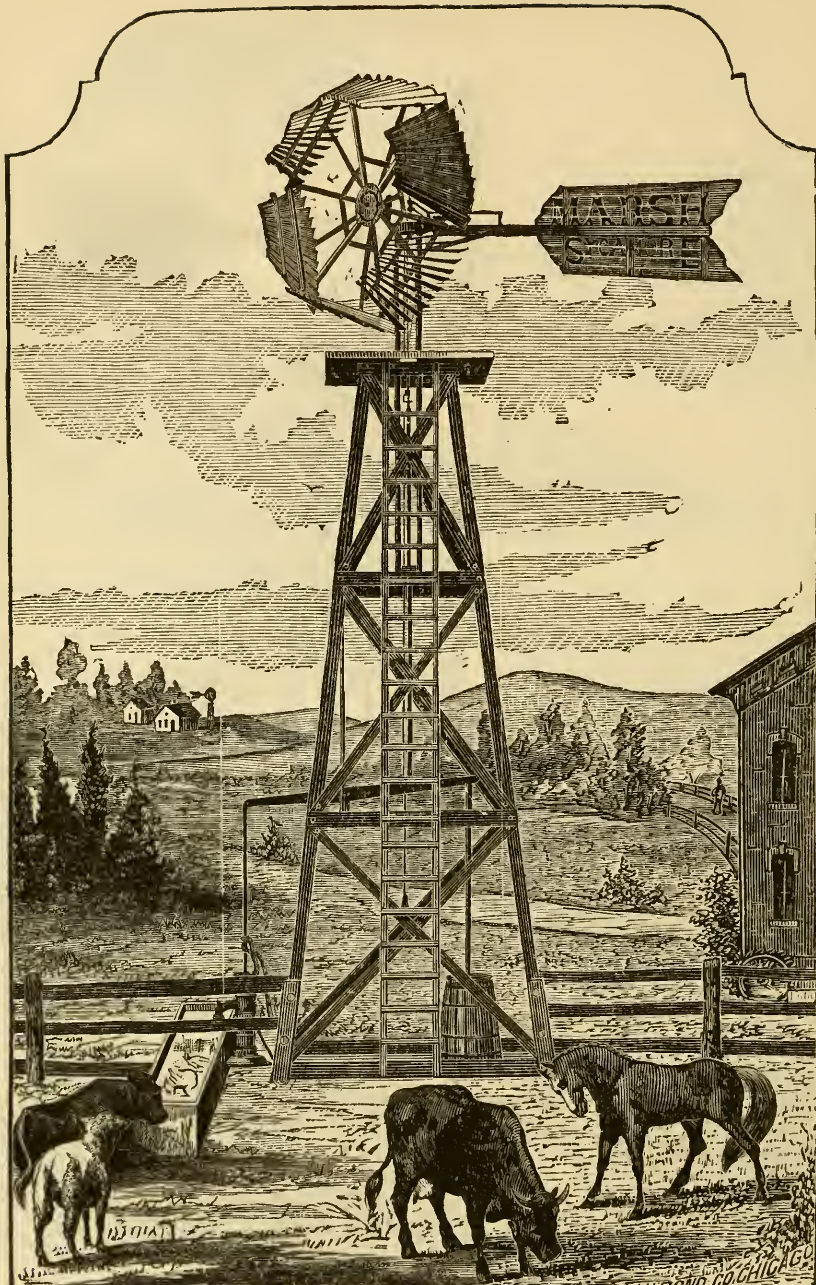
It was fortunate, therefore, for the prosperity of the country, and especially for the prosperity of its agriculture, constituting by far the largest and most important interest, that just about the time when a more extensive demand for its surplus products grew up in Europe, the means were provided for throwing this surplus into good markets.

After the triumphant termination of the war of the Revolution, the importance of developing the material resources of the country impressed itself upon the minds of far-seeing statesmen. Washington himself projected a canal, extending up the Potomac, to connect the great west—then comparatively uninhabited—with the Atlantic coast, and though the enterprise was premature, and the requisite capital could not, at that time, be procured, it shows the grand conception of his noble mind, and that he foresaw the vast importance which the agricul-




THE MARSH WIND MILL.

The best made Mill in the market, having a Steel Graduating Crank Shaft, babbitted boxes, turned travellers, lathe-fitted turning table, turned pitman and lever irons, thus saving all wear and consequent loss of motion. Its bolts are rivetted or double nutted, and the segment castings are self-locking.




THE MARSH WIND MILL.

The only Mill with a Graduating Crank, that gives a longer or a shorter stroke to pump in proportion to the force of wind.

ture of that great country was destined to assume. But that state of things could not always remain in a country rapidly recovering from the stagnation of a long protracted struggle for independence, and the events of a second war showed most clearly the necessity of increased facilities of intercommunication. Then we had no canals to speak of, and no good roads. The great extent of sea coast, the magnificent bays, and the mighty rivers which intersected the country were the chief means of industrial intercourse, and these could be blockaded, crushing our commerce and bankrupting individuals, to the serious injury of the whole country. Then DeWitt Clinton conceived the project of connecting the waters of the Hudson with those of Lake Erie, by a canal so vast in extent as to strike everybody with astonishment. President Madison went so far as to express the opinion that it could not be accomplished, even with the treasures of the whole federal government. But Clinton persisted, and in 1825, eight years from the time it was begun, a canal of three hundred and fifty miles in extent, costing at that time over $9,000,000, bore the produce of the west to the New York market.

The success of this grand enterprise stimulated other improvements of a similar character, and opened up sources of wealth, the mere enumeration of which would appear to be fabulous. Railroads soon followed, annihilating distance, as it were, and bringing the growing centres of trade into close communication. We now have about 100,000 miles of railroads, forming a complete network all over the country. At the time of the Revolution, the great state of Ohio was a wild forest that had rarely been penetrated by any white man, except, perhaps, the adventurous hunter. In 1800 she had but little over 40,000 inhabitants. Now railroads connect her many large and prosperous cities and her innumerable villages, and take the produce of her fertile farms to the seaboard markets.

These means of communication are of so recent date, that any prediction of their ultimate results in developing the agricultural resources of these states would be premature. Indeed, the capacity for the production of human food, which is still comparatively undeveloped in that section, can hardly be estimated. The progress within the last thirty years has been so rapid and unprecedented, as to appear altogether marvellous.

But Indian corn, while it is the most important product in its money value, is not the only great staple production of the country, and we turn our attention to

WHEAT.

The wheat crop of the country is of about three-fifths the value of Indian corn, and, in some respects is quite as important. This, like the other grains, was cultivated in this country at a very early date, having been sown by Gosnold, on the Elizabeth Islands, on the southern coast of Massachusetts, as early as 1602, at the time he first explored that coast. In 1611 it seems to have been first cultivated in Virginia, and so much did it commend itself to the early settlers, that in 1648, if history is to be relied on, there were several hundred acres in that colony. It soon fell into disrepute, however, as a staple crop, for the cultivation of tobacco was found to pay better, and for more than a hundred years it was comparatively little cultivated. Premiums were offered to encourage its culture, but they were not sufficient to check the growing attention to tobacco.

It is certain that wheat had been cultivated by the Dutch colony of the New Netherlands, for it is recorded that samples of this grain were taken to Holland in 1626, to show what could be done in the new country.

It is not certain that it was cultivated in the Plymouth colony immediately upon its settlement, though it is highly probable that not more than a year or two would have been allowed to pass before so important a plant would have received its due attention. In 1629, wheat and other grains for seed were ordered from England, and in 1631 there arrived a vessel with thirty-four hogsheads of wheat flour.

The culture of wheat was undoubtedly commenced almost simultaneously with the settlement of the country, but it seems never to have attracted any very great attention for more than a century, Indian corn and potatoes being more relied upon for subsistence. It was never raised in New England, in early times, with so much success as it has been during the present century. As early as 1663, it was found to be very subject to blast and mildew. Early in July of that year, "the best wheat," says an old manuscript diary that I have consulted, "as also some other grain, was blasted in many places, so that whole acres were not worth reaping. We have had much drought the last summer (1662), and excess of wet several other springs, but this of blasting is the first so general and remarkable that I yet heard of in New England."

But this blasting is frequently "heard of" afterward, for the very next year (1664) the wheat was very generally blasted, "and in sundry towns scarce any left." And the blast returned again in 1665 and 1666 with great severity. This explains why it never became a prominent crop in New England. There never was a time in the history of this section of the country when it was a sure and reliable crop, unless it be the present, with our improved modes of culture, our better knowledge of proper modes of tillage, deep ploughing, and thorough drainage. I have no patience to read the cant which is constantly paraded in the papers of this and other countries about the exhausted soils of New England. How often do we see it stated that they are "run out," that they won't bear wheat, and the return of the census of 1860 is compared with that of 1850 to show an enormous falling off, as if it were owing to the fact that it is impossible to grow wheat. It is not so. As good crops can be and are grown in Massachusetts now as there ever were. It is as safe a crop now as it ever was, and as profitable. But "the census shows a falling off," is constantly sounded over the country, till people are led to believe it cannot be raised on account of the impoverished condition of the soil. The census does show a decline of this crop in New England between 1840 and 1850, and a large one. But the wheat crop was injured in 1849—that being the year on which the statistics of the crops of 1850 are returned—to a degree wholly unprecedented, not only in New England, but in several of the largest wheat-growing states. The returns, therefore, made in June, 1850, do not correctly indicate the usual quantity of grain grown in the United States. Nor did the census of 1860 give any thing like an adequate idea of the magnificent crop of wheat produced in that year (1860) throughout the northern, middle, and western states.

But wheat is subject to many losses by insects, rust, smut, frost, drought, storms, and other casualties, as well as poverty of the soil. Some years since the crop was very greatly damaged in central and western New York, and in Ohio, by the wheat fly; in other years by the weevil. When the former, the wheat fly, makes its appearance, there is no known remedy but to discontinue the culture of wheat in that locality till it disappears. After a time, the culture of wheat may be resumed with a reasonable hope of freedom from this pest. This is one reason of the little attention, comparatively, paid to the culture of this crop in New England for the last few years. The farmers in many localities have resumed its culture again. There are many magnificent wheat fields in Massachusetts which have averaged for several years past twenty-five, thirty, and thirty-five bushels to the acre, of as full and fair a kernel as ever grew; and many an acre in Massachusetts has yielded over forty bushels of excellent wheat. It is the opinion of many practical farmers that they can raise thirty-five bushels of wheat as easy as fifty bushels of corn to the acre. But the census of 1860 did not return the full crop.

There were other reasons for the falling off than the impoverishment of the soil. A part of these have been alluded to, and are to be found in the comparative uncertainty of the crop; but a more direct and important cause was the opening of direct railroad communication, and the cheap freight system, with the west. The farmer could produce other crops for the market which paid well, and it was better for him to buy flour than to raise it. He could not compete with the west in raising wheat, but he could in raising milk for the market, in raising fruit—which finds a ready sale at his door—in raising vegetables, which the multiplication of manufacturing villages in his neighborhood created a demand for. And so his industry was merely turned into another channel for a time, and very wisely too.

During the last century considerable quantities of wheat were raised along the Hudson and the Mohawk, and in New Jersey and Pennsylvania; and, as we have seen in the case of Indian corn, the exports were somewhat respectable in years of scarcity in Great Britain, France, Spain, Portugal, and the West Indies, even previous to 1723. In 1750 New Jersey took the lead of all the colonies in growing wheat.

The amount of flour exported from New York in 1749-50, was 6,721 tons, besides many bushels of grain; in 1756 it was 80,000 barrels. The amount exported from New Jersey in 1751 was 6,424 barrels. The amount shipped from Philadelphia in 1752 was 125,960 barrels, and 86,500 bushels of wheat. In 1771 the export of flour from that place was 252,744 barrels, and in 1772, 284,827 barrels; in 1784, 201,305 barrels; in 1787, 193,720 barrels; in 1791, 315,785 barrels. Virginia, for some years prior to the Revolution, exported about 800,000 bushels of wheat.

EXPORTS OF WHEAT AND FLOUR FROM THE UNITED STATES AT CERTAIN DATES.

| Year. | Flour, bbls. | Wheat, bush. | Total Values. |
|---|---|---|---|
| 1791 | 619,681 | 1,018,339 | |
| 1800 | 653,052 | 26,853 | |
| 1810 | 798,431 | 325,024 | |
| 1862 | 4,882,033 | 37,289,572 | |
| 1870 | 3,463,333 | 36,584,115 | $68,340,822 |
| 1874 | 4,094,094 | 71,039,928 | 13[illegible],679,553 |
| 1879 | 5,629,714 | 122,353,936 | 160,268,792 |
| 1880 | 6,011,419 | 153,752,795 | 225,879,502 |

From 1840 to 1850 the increase of the wheat crop was, according to the census, only 15 per cent., mainly from the fact that the crop of 1849, the census year, was a very bad one. In the next decade, (1850 to 1860) the increase was 60 per cent. In 1870 the distinction was first made between spring and winter wheat, and the increase from 1860 was 66 per cent. From 1870 to 1880 the increase was 73 per cent. The aggregate number of bushels in 1840 was 84,823,272; in 1850 it was 100,485,944; in 1860, 173,104,924; in 1870, 287,745,626; in 1879-80, 459,591,093 bushels. During these four decades the center of wheat production was moving rapidly westward. In 1850 and 1860 there was no considerable falling off in the wheat production of New England, which had at no time been actually large, averaging a little less than 1,100,000 bushels annually. Of the Middle States New York, Pennsylvania, and Ohio had been the largest producers in 1850, in about the ratio of 13, 15, and 14,000,000 bushels; in 1860 the ratio changed to 8½, 13, and 15, while Illinois, Indiana, and Wisconsin had passed them all. In 1870 New York had sunk to the eleventh place, while Illinois and Iowa contended for the first, and Indiana, Ohio, and Wisconsin were not far in the rear. New England had 958,000 bushels, all told. In 1880 New York had dropped to the 15th place, and Illinois, Indiana, Ohio, and Michigan occupied the leading position, followed closely by Minnesota, Iowa, California, Missouri, and Wisconsin. The indications are that in five years, Minnesota, Iowa, Kansas, and California will occupy the leading places, and Dakota and Nebraska will contest the places of Illinois, Indiana, Ohio, and Michigan.

The first foothold that agriculture obtained in this vast field was secured in the same year of the founding of Philadelphia, 1682, when white settlements were made in the southern part of what is known as the "American bottom," a tract of country extending for about a hundred miles in length—from Alton, twenty miles above St. Louis, down to Chester, at the mouth of the Kaskaskia river—by five miles in width. This region lies in Illinois, and forms the eastern border of the Mississippi river. Here, far removed from eastern civilization, a bold and hardy, but honest and peaceable company of French, from Canada, and from France itself, established the old villages of Kaskaskia, Prairie du Rocher, St. Philip, Cahokia, etc., chiefly for the purpose of opening a fur trade with the Indians. A part, probably at least half, of the settlers, however, finding the soil exceedingly rich, devoted themselves to the cultivation of land, and the country for a considerable extent around these villages soon became productive of wheat and other necessaries of life.

This was the first settlement beyond the Alleghany mountains, and preceded by a whole century the first settlements of Kentucky and Tennessee. For a hundred and fifty years those farmers lived in peace and harmony with the natives. They were not, to be sure, very skilful in the art of agriculture. It was but rudely pursued at that time in the mother country. The implements used in farming, even in the best cultivated regions of Europe, were then extremely rude as compared with those of the present day; but here, in this remote outskirt of civilization, they were far more rude and uncouth than those used by farmers who had greater facilities for making them.

But notwithstanding this rude and imperfect culture, so great was the fertility of the soil to which it was entrusted, that the wheat grew luxuriantly, and they often had a surplus, useless and comparatively worthless to them, since the expense of getting it to market exceeded its value when it had arrived there. Who would be expected to make improvements in farming under such circumstances? With the demand for home consumption supplied with but trifling labor, with no inducements beyond a supply of their own limited wants, they could not be expected to exhibit the enterprise and thrift of farmers having greater interests at stake. But they went further, and entertained the same prejudice against any new notion, and repugnance to any change, as that cherished at the same time in the older colonies. The old-established practice was good enough for them, and they clung to it with a tenacity worthy of a better cause.

The cultivation of Indian corn was not introduced among these early western farmers till long after they established themselves in that region—not, indeed, till after Louisiana had become a part of our national territory; but then, it took the place of wheat to a considerable extent, it being thought a more reliable crop, while the stalks furnished a more valuable winter fodder for cattle. When once introduced, it was cultivated on the same land year after year, for many years in succession, a practice which was continued in that section till a very recent date. Instead of linens and woollens, which were mostly worn at the same period among the country people at the sea-board, these farmers usually raised a small patch of cotton, and made their own garments, often using, also, the skins and furs of wild beasts. These latter became so important, as to be used as the currency in business negotiations, a deer-skin being of the highest value, and serving as the unit.

Thus lived these quiet colonists, without change, and with slight improvements, from one generation to another, poor but independent, with food enough, cattle and hogs enough, few wants to supply, clinging with inveterate tenacity to old customs, and resisting innovations, till the time of the cession of the country east of the Mississippi by France to England, in 1763, at which time the colony was at the height of its prosperity. The horses they raised were the small Canadians, said by some to have been derived from the pure Arabian, and obtained originally through Spain. They were very hardy, more so than the American horses of that time, and were rarely crossed with any other race; but little or no care was taken of them for more than a hundred years, and they were allowed to run on the range without grain. Their cattle were small, with black horns, derived also from Canada. The French kept large numbers of fowls, usually had excellent gardens, and cultivated some fruit, among which were some valuable varieties of pears and apples.

That section of country being conquered and taken from England in the Revolution, not a few of the American soldiers, finding the country so fertile, remained and settled there; and it is said, that at least three-fourths of the Americans who had settled in Illinois previous to the war of 1812, had served as soldiers in the Revolution.

After the Revolution still more numerous settlements were made, till, in 1817, the state was admitted into the Union. After that period, farms and farmers increased more rapidly than they had hitherto done, and the production of wheat and Indian corn rapidly increased. The cradle soon took the place of the sickle. In 1830 the first successful steam flour mill was erected, and gave a new impulse to the raising of wheat. Up to this time, comparatively few cultivated meadows were to be found, and the wild, coarse grasses of the prairies and river bottoms were chiefly relied upon for winter fodder for horses and cattle. Of course, when cattle are running at large, but little improvement can take place in the breed, and but little had actually been attempted in this direction. But now the spirit of improvement began with renewed vigor, and we shall see how rapidly the agricultural resources of that great state have been developed within the last quarter of a century.

What applies to this particular state, will apply with nearly equal truth to almost the whole of the great north-west. The progress of agriculture in Illinois and the adjoining states cannot be better illustrated than by referring to the rise and growth of the city of Chicago, which has now become the greatest primary grain depot in the world, its exports being nearly twice as great as those of St. Petersburg, and exceeding those of Galatz and Ibrail combined, by upward of five millions of bushels a year.

In 1829, Chicago may be said to have had no existence. It was then laid out, and the sale of lots took place in the autumn of that year. In 1840 it contained but 4,853 inhabitants. In 1845 its population had grown to 12,088, in 1850 it amounted to 28,269. In 1855 it had increased to 88,509, in 1860 to 109,264, in 1870 to 298,977, and in 1880 to 503,304.

The pre-eminence of Chicago as a grain depot is due in part to its geographical position, but to a great extent, also, to the great facilities for receiving, warehousing, and shipping grain. Her immense warehouses are erected on the river and its branches, and railroad tracks run in the rear of them, so that a train of loaded cars may be standing at one end of a large elevating warehouse, and while its load is being raised by elevators at the rate of from 7,000 to 8,000 bushels per hour, at the other end the same grain may be running into vessels, and be on its way to Buffalo, Montreal, or Liverpool within six hours' time. The Illinois Central railroad grain warehouses can discharge twelve cars loaded with grain, and at the same time load two vessels with it, at the rate of 24,000 bushels per hour. They can receive grain from twenty-four cars at once, at the rate of 8,000 bushels per hour. And numerous other immense grain houses can do the same thing. Grain can, therefore, be handled with wonderful dispatch as well as with cheapness. The warehouse alluded to, that of the Illinois Central railroad, is capable of storing 1,500,000 bushels of grain. It can receive and ship 65,000 bushels in a single day, or it can ship alone 225,000 a day! But this is only one of the magnificent grain warehouses, and there are many others, some of which are of nearly equal capacity, and in the aggregate they are capable of storing 3,395,000 bushels. They can receive and ship 430,000 bushels in ten hours, or they can ship alone 1,340,000 bushels in ten hours, and follow it up the year round. In busy seasons these figures are often doubled by running nights.

The amount of capital in grain warehouses alone exceeds eight millions of dollars, to say nothing of a large amount of capital invested in other incidental means of conducting this immense business.

The first shipment of wheat from Chicago was made in 1838, and consisted of 78 bushels. In 1853 the shipments were, of wheat, 1,680,999 bushels; Indian corn, 2,780,253 bushels; oats, 1,748,493 bushels. In 1857 they had risen to, wheat, 10,783,292 bushels; Indian corn, 6,814,615; oats, 416,778 bushels. In 1867 they were, wheat, 10,360,458 bushels; Indian corn, 20,213,790; oats, 9,732,146; rye, 1,008,623; and barley, 1,680,950 bushels. In 1877 they were, wheat, 15,406,123; corn, 46,532,795; oats, 12,721,435; rye, 1,577,172; barley, 4,381,857. The shipments of flour had been increasing in an equally rapid ratio. In 1853 131,130 barrels were shipped; in 1857, 489,934 barrels; in 1864, 1,170,274 barrels, in 1867, 1,859,995, and in 1877, 2,568,724 barrels. The receipts of grain each year were generally from 15 to 25 per cent. beyond the shipments, large quantities of wheat and corn being converted into flour and meal in the city. Reducing the flour to grain, the shipments of cereals, of all sorts, were, in 1854, 12,902,320 bushels; in 1857, 18,032,678 bushels; in 1862, 56,484,110 bushels, and in 1877, 93,153,002 bushels.

The returns of receipts and shipments for 1878 and 1880, which exhibit the receipts from the Red River Valley, and the wheat lands of Dakota and Montana show a greater increase. The country is still sparsely settled, compared with the older states, and the operations of agriculture are carried on under great disadvantages, with a great scarcity of labor, and in many cases a want of capital.

The reader will now be able to appreciate, to some extent, the vast importance of the improvements in agricultural implements and machinery, which have already been described on a preceding page as having been made within the last twenty-five years. With the implements and processes in use within the memory of most men, it would be impossible to attain such magnificent results in the way of agricultural produce. There are at the present time, in the city of Chicago, some ten or twelve large manufactories engaged in making and selling agricultural implements and machinery, each employing from one hundred to three hundred hands, besides other large establishments at Rockford, Freeport, Alton, and many other places, employing throughout the state more than ten thousand persons. There are at least fifty reaper and mower manufactories, and other establishments devoted to making threshers, cultivators, ploughs, drills, lawn mowers, etc., and the demand for these improved machines is rapidly increasing.

But enormous as are the facilities of Chicago for receiving and shipping agricultural products, she has rivals in some of the departments of this traffic which press her very closely, though none has so large a trade in all descriptions of produce. Milwaukee has, for the last five or six years equaled and sometimes surpassed her in the receipts and shipments of wheat and wheat flour; St. Louis nearly equals her in the provision trade, but none of them maintains the supremacy in all respects, which Chicago has attained and holds. But Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Louisville, New Orleans, and to a less extent Richmond, Charleston, and Norfolk are points of great importance for the receipt and shipment of agricultural products.

In view of these facts we can realize that agriculture produces, as was estimated in 1880, by the superintendent of the census, more than thirty-five hundred millions of dollars a year, and that in the State of New York where the assessed value of the real estate is twenty-seven hundred millions of dollars ($2,681,970,833 in 1880) notwithstanding the enormous wealth of the metropolis, the agricultural interest pays three-fifths of the taxes.

It is interesting to notice, how rapidly the west has gained upon the east in the production of this crop (wheat) in the past forty years. In 1840, and even in 1850, the great wheat growing States were New York, Pennsylvania, and Ohio; while Indiana and Illinois were gradually advancing to the first places. In 1860 the largest production was west of the Ohio River; in 1870 it was west of the west line of Ohio; in 1880 it was west of the west line of Indiana, and in 1890 and perhaps earlier, it will be west of the Mississippi River. That portion of the Southern States lying east of the Mississippi, and especially Virginia, Maryland, Kentucky, Tennessee, and North Carolina, raised considerable wheat of an excellent quality before 1860, but their production has since that time greatly diminished, and the whole region east of the Alleghanies, north and south, with Alabama, Mississippi, and Louisiana thrown in, does not now produce more than one-seventh of the wheat crop of the United States, while the States and territories lying on the Mississippi and its branches, and west of that river, and the States of Michigan and Wisconsin produce over 400,000,000 of wheat, or six-sevenths of the whole crop. In 1879 half this amount was still grown east of the Mississippi, but in 1880 the great crops of California, Oregon, Minnesota, Iowa, Kansas, Nebraska, and Dakota had turned the scale. The production of these seven States and territories alone exceeded 200,000,000 of bushels, and with the other States and territories made up an aggregate of at least 225,000,000.

Two or three causes have aided largely in producing the wonderful development of wheat culture in the trans-Mississippi region. It was early discovered that in the rich soil of California wheat was not only very productive, but the berry was larger and contained a much larger proportion of gluten than the eastern wheat, and was better adapted to exportation. The area cultivated in wheat has increased rapidly, as it proved a profitable crop. Later it was found that the wheat of Oregon and Washington possessed similar qualities.

It was long supposed that the region above the 46th parallel in Minnesota, Dakota, Montana, and Idaho was too cold for wheat to be a certain crop; the winter wheat in all that region, which has an elevation above 1,000 feet above the sea was liable to be winter killed, but it was finally discovered that spring wheat uniformly yielded good crops on this elevated land in these high latitudes, and when the further discovery was made that the spring wheat was substantially identical with the California wheat, weighing from 62 to 69 pounds to the bushel, and that under the "new process" of grinding — using the "middlings purifier" it made the best flour in the world, there was a very speedy development of wheat culture in all the new northwest. The Valley of the Red River of the North and the plains west of it have now the reputation of being the best wheat region on this continent—but they grow only spring wheat. Iowa farmers sow both spring and winter wheat but their crops are more sure with the former. Missouri, Nebraska, and Kansas, on the contrary, sow winter wheat exclusively.

PRODUCTION OF OTHER GRAINS.

Rye was introduced and cultivated in all the colonies at the earliest periods of their settlement, and was mixed with Indian meal for the making of bread, in New England, as early, certainly, as 1648, and perhaps even as early as 1630, and that custom became very common. The export of this grain has never been very extensive, and since the demand for wheat has been so much increased, its extent of cultivation has diminished rapidly.

In 1796, no less than 50,614 barrels of rye meal were exported from Philadelphia, and in 1801 the United States exported 392,276 bushels of rye. In 1842 the export was only 82,705 bushels.

The variation in the amount of the rye crop from one decade to another is not very great. It is less used for distillation now than it was forty or fifty years since, but it is more in demand for breadstuffs. In 1840 there were 18,645,567 bushels returned; in 1850, only 14,188,813 bushels; in 1860, 21,101,380; in 1870, 16,918,975, and in 1880, 19,863,632 bushels. Illinois, New York, Pennsylvania, Wisconsin, Kansas, Ohio, Nebraska, and Kentucky grew about three-fourths of the crop. The straw is very valuable and in great demand.

Oats.—The culture of the oat was introduced into the colonies immediately after their settlement by Europeans, having been sown by Gosnold, on the Elizabeth Islands, as early as 1602, and cultivated to greater or less extent from that time to the present. But though much more extensively produced than rye, its consumption as food for animals is so great in this country, that it has never formed any considerable article of export, though an average of about 70,000 bushels was shipped for some years previous to 1820.

The oat crop in 1840 was returned as 123,071,341 bushels; that of 1850 as 146,584,179 bushels; that of 1860 as 172,643,185 bushels; that of 1870 as 282,107,157 bushels, and that of 1880 as 407,770,712 bushels. The geographical distribution of the crop of 1879–80 was as follows: The New England States raised 9,683,400 bushels; the Middle States, 107,400,590 bushels; the southern and southwestern States 39,634,000; the Western States and territories, 206,848,330 bushels. Illinois takes the lead in this crop, producing nearly 47,670,400 bushels; New York comes next with 40 millions, and Iowa is third with 37,256,400. The other states which yield the largest crop of this grain are Pennsylvania, Wisconsin, Minnesota, and Ohio. None of the other States produced 20 million bushels.

Barley, like the other grains already mentioned, was sown on the first settlement of the colonies, having been first cultivated by Gosnold as early as 1602, on the Elizabeth Islands, on the Massachusetts coast, and by the settlers at Jamestown, in Virginia, in 1611, where, however, it soon gave way to the more lucrative production of tobacco. Samples of it were sent from the Dutch colony at New York, in 1626. Good crops of it were raised in the colony of the Massachusetts Bay as early as 1630; and in 1796 the principal agricultural product of the State of Rhode Island was barley.

For many years, barley was not a favorite crop in any part of the country; and was raised only for malting and distillation, and even for this purpose the supply was materially below the demand. On the Pacific coast, however, it succeeds better than oats, and is preferred for feeding horses, and also for distillations. In 1840 the barley crop was returned as 4,161,504 bushels; in 1850 as 5,167,015 bushels, in 1860, as 15,825,898 or three-fold what it was in 1850. California already took the lead, in 1860, returning 4,415,426 bushels, while New York returned only 4,186,668, Ohio 1,663,868, and Illinois 1,036,338 bushels. In 1870, the barley crop was 29,761,305 bushels, of which the Pacific States and territories raised $9\frac{1}{2}$ millions, or nearly one third. In 1879–80 the yield was reported at 44,149,479 bushels, of which the Pacific coast furnished 15,500,000. The crop of 1880 was not less than 46 million bushels.

Buckwheat.—This grain has never been cultivated to any great extent in this country, though it was introduced into the colony at Manhattan Island by the Dutch West India Company, and raised there as early as 1625 or 1626. Its culture was continued by the Dutch to some extent, and they used it as provender for horses. It was also cultivated by the Swedes, who settled along the Delaware, in New Jersey and Pennsylvania.

None of the southern or southwestern states, except Virginia and West Virginia, have ever made much account of this crop. A few acres were sown with it in North Carolina, Kentucky, and Tennessee, but Pennsylvania, New York, Michigan, and Ohio are the principal states for buckwheat. In 1840, the number of bushels of buckwheat returned was 7,291,743, in 1850, 8,596,912; in 1860, 17,571,818; in 1870, 9,821,721; in 1880 was some increase from previous years, 11,851,738 bushels being reported. The value of the crop in 1870 was about $10,000,000, and in 1880, it was $7,856,191. The great corn and wheat growing belt, New York, New Jersey, Pennsylvania, Ohio, Michigan, Iowa, Illinois, Indiana, Wisconsin, and Minnesota produced in 1879, 12,421,400 of the 13,140,000 bushels yielded that year.

The cultivation of buckwheat has the

effect to cleanse the land, which has been one reason for its increase, while the price it commands makes it a profitable crop.

### CLOVER AND GRASS SEED.

The production of clover and other grass seed for seeding lands intended for meadow purposes has become an item of some importance, though it is doubtful whether the crop is increasing in this country. There are considerable quantities imported every year, though not, we believe, much exceeding a value of $650,000.

The crop of clover seed reported in 1860 was 956,188 bushels. In 1870 it had fallen off to 639,657. The production of other grass seeds in 1860 was 900,040 bushels; in 1870 it had decreased to 583,188 bushels. The amount produced in 1880 of both can only be known when the agricultural statistics of the tenth census are ready, but it is probable that there has not been a large increase. The crop of 1870 was worth nearly $5,000,000. Pennsylvania led in clover, and Illinois in grass seed.

### THE POTATO.

The potato is more universally cultivated in this country than any other crop, excepting, perhaps, Indian corn. At what time it was first introduced, as a cultivated plant, into the American colonies, is not known, but it was, no doubt, soon after the settlement. It is mentioned among the seed ordered for the Plymouth colony, as early, certainly, as 1629, but it was not recognized, probably, as an indispensable crop, till near the middle of the last century, when it appears to have been very widely known and esteemed. As many as 700 bushels were exported from South Carolina in 1747, and in 1796 no less than 9,004 bushels were shipped from Philadelphia.

It is well known that the sweet potato was first introduced, and came to be regarded as a delicacy in England, and the allusions to the potato by the earlier English writers who mention this plant, refer to the sweet, and not to the common potato.

It has formed a somewhat important article of export, though by no means to be compared, in this respect, with wheat and Indian corn. We exported in 1821–2 about 129,814 bushels, valued at $45,758. In 1844–5 the export amounted to 274,216 bushels, valued at $122,926. The number of bushels of potatoes returned by the census of 1840 was 108,298,060. In 1850, 65,787,896 bushels; in 1860, 111,848,817; in 1870, 143,337,473; in 1879, 181,626,400, and in 1880, 168,385,900. In 1850 there were 38,268,148 bushels of sweet potatoes; in 1860, 42,095,026; in 1870, 21,709,824.

Peas and Beans.—Though not entering extensively into the commercial interests of the country, the product of peas and beans is still important, both from its extent and value for home consumption.

Beans are said to have been first cultivated by Capt. Gosnold, on the Elizabeth Islands, as early as 1602. They appear to have been cultivated by the Dutch, at Manhattan, in 1644, and about the same time in Virginia; but are said to have been previously raised by the natives.

In the year 1755, the amount of peas exported from Savannah was 400 bushels, and in 1770, 601 bushels. The amount exported from Charlestown in 1754 was 9,162 bushels. North Carolina exported 10,000 bushels in 1753.

The total amount exported annually from the United States for 20 years previous to 1817, was 90,000 bushels, while the beans annually exported during the same period amounted to from thirty to forty thousand bushels.

The census of 1850 returned the amount of peas and beans as 9,219,901 bushels. The value of these crops exceeded $16,000,000; that of 1860, as 15,061,995 bushels, valued at about $45,000,000; that of 1870, as only 15,746,027 bushels, value not given.

### THE GRASS AND HAY CROP.

Owing to the necessity that exists throughout all the northern portion of the United States to stall-feed the stock from three to six months of the year, the grass and hay crop assumes there an importance which it has not in the more southern portions of the country.

I have alluded, briefly, on a preceding page, to the fact that, at the time of the early settlement of the colonies, no attention had been paid in the mother country to the cultivation of either the natural or the artificial grasses. Attention to this branch of farming was gradually forced upon the settlers of the more northern portions of the country. For want of sufficient and suitable winter nourishment, the cattle, which were scarce and expensive, were often found dying of starvation, notwithstanding the efforts made to secure a supply of salt hay from the many marshes in the vicinity of the Plymouth and the Massachusetts, as well as the Dutch and Swedish colonies.

It was, no doubt, many years before it became possible, in the nature of things, to provide full supplies for their cattle, and it was not unfrequently the case, even after the culture of grasses was introduced, that the cattle were obliged to browse in the woods in a long and hard struggle for life, owing to the loss of crops by drought and imperfect cultivation.

The cultivation of timothy, the most important and valuable of the forage grasses, was not introduced, according to Jared Eliot, who wrote in 1750, till a few years previous to that date, having been found by one Herd, in a swamp near Piscataqua. He propagated it till it was taken to Maryland and Virginia by Timothy Hanson, after whom it is most frequently called. The well-known orchard grass was cultivated as early as the middle of the last century, for we know it was introduced from Virginia into England in 1764, or thereabout. The June, or Kentucky blue grass, was probably indigenous, and sprung up in the pathway of the settlers, as it does now, wherever the footstep of civilization penetrates. But it was not till a recent date that the general culture and improvement of the grasses received the attention it deserved.

The grasses spring up almost spontaneously in many localities, it is true, otherwise the settlers would have suffered far more severely than they did. From the time when the great mandate went forth, even before the creation of man, "Let the earth bring forth grass," it has been a law of nature to clothe the earth with verdure as soon as the advance of civilization lets in the light upon the soil by the first clearings of the pioneer settler.

The progress made in the cultivation of grasses and the production of hay has been greater within the last half century than ever before. This will appear, especially when we consider the improvement in the means of cultivating and harvesting the crop. The culture of clover had been commenced, in some parts of the country, previous to that time, but it had not established itself in the farmer's favor to any very great extent, and the indigenous grasses were chiefly relied on, while the seed used in many parts of the country was that which had fallen from the hay-mow, foul, of course, and full of weeds.

According to the census of 1840, the hay crop of the United States was 10,248,108 tons. In 1850 it was 13,838,642 tons, an increase of 3,590,533 tons. In 1860 it was 18,083,896 tons with a value of not less than 209 million dollars; in 1870 it was 27,316,048 tons, worth $356,474,426; in 1879 there were 35,493,000 tons, worth $330,884,494; a greater amount than any other agricultural product, except Indian corn. If we add to this the value of the grass crop (pasturage and soiling feed), which is more than equal to that of the hay, we have an amount exceeding that of corn.

The production of hay is, to a certain extent, a tax upon the farmer imposed by the severity of climate. In a mild climate and short winters, the necessity for curing hay in any considerable quantities is avoided. Less hay is made, of course, at the south than at the north. The same number and size of cattle would require less artificially prepared fodder in a mild climate than in a severe one. Maine, for instance, in 1879, raised 1,248,000 tons of hay, and kept 446,000 head of cattle and horses, about one-third of her hay crop being exported. Illinois, with 2,548,500 tons of hay kept 3,008,000 head of cattle and horses, using about thirteen-fifteenths of a ton per head; while Alabama, which made only 34,900 tons of hay, kept 599,612 head of cattle, the proportion being but one ton of hay to seventeen head of cattle. There is some compensation in this, and that is the extreme difficulty of growing the ordinary natural grasses in a southern latitude, on account of the severe droughts. It is almost impossible to produce a fine, close, permanent turf south of 39° N. latitude, and considerable quantities of cured hay are taken from the north to southern ports every year.

There is, also, another most important compensation in the greater facility afforded by the wintering of cattle for economizing manure, and thus keeping up the fertility of the soil. For example, tobacco culture is said to have impoverished the soil of Virginia. One reason for it was, that keeping comparatively few cattle, and never housing them, but rather "browsing" them from one year's end to another, there was no possibility of saving and making a great quantity of manure. Till the introduction of guano, it was extremely difficult to get manure for the tobacco field, and exhaustion was inevitable. In Massachusetts, on the other hand, there is no crop that a wheat or corn crop will follow so well as that of tobacco, for the reason that the grower, knowing the requirements of the plants, manures it very highly, as he easily can, and the soil, instead of being exhausted from year to year, is actually growing richer.

The geographical distribution of the crop was returned in 1879 as follows:—

The Eastern and Middle states produced 17,835,800 tons, valued at $193,042,992; the west produced 1,475,300 tons, valued at $18,303,324; and the south and southwest produced 16,181,900 tons, valued at $119,056,078.

No account of crops for winter feeding would be complete at the present time which neglected to give some account of the newly introduced system of ensilage which increases five-fold or more the number of cows or other cattle which can be kept on a given area of land, greatly reduces the cost of their support, improves their capacity as milk producers or as stock for the shambles, and, by increasing largely the amount of manure, renders the land constantly richer and more productive.

Ensilage derives its name from *silo*, a pit or out-of-door cellar lined with cement —the bottom being also of cement—in which is packed green fodder—corn cut when the ear is in the milk, millet, rice corn, sorghum, Hungarian grass, lucerne, or alfalfa—each cut before being ripe, and reduced by means of a straw-cutter to pieces an inch and a half in length, put into the *silo*, and each layer trampled down solid, till the *silo* is filled to near the top, when a thick layer of straw is put on, and boards cover it, matched so as to fit closely, and heavy weights put on, the whole covered with a thatch or other roof to shed rain or snow. When the ensilage, as the mass is called, is to be fed out, access is obtained to it on the side where a doorway has been previously dug out and blocked up. The mass is cut down with a hay-knife, and fed either alone or with grain, oil-cake, squashes, pumpkins, or carrots. It is not necessary to begin with this fodder until late in November, or in some sections till the first of December. The *silo* should be large enough to contain from 125 to 200 tons of ensilage—and with this supply, which, aside from the cost of the *silo*, will not exceed a dollar a ton in cost, a farmer on a farm of fifty acres can keep from 80 to 100 cows, and his land be constantly growing richer from the manure. The system is rapidly growing in favor in the east, and is beginning to be introduced in the south and west.

In this connection, also, something should be said of the cultivation of forage grasses, so extensively practiced in the west, and becoming more and more prevalent in the east and south. On the Pacific slope, and especially in California, Arizona, and Nevada, the preservation of anything like a sod is impossible; the long hot season burns up the roots of the grasses, and only annual grasses can be cultivated, unless they are those having very strong and deep roots, and these do not usually make a good sod. Partly from this, and partly from other causes, the cultivation of forage grasses has become very general, not only on the Pacific slope, but in all those states and territories occupying what are known as "The Plains." On the Pacific coast, alfalfa, a species of lucerne clover, which has deep and strong roots, grows two or three, and sometimes four, crops in a year, and is much relished by cattle. Next in order come: Hungarian grass, a species of German millet—Egyptian rice corn, or Dhourra, largely grown in Kansas —Pearl millet, Indian corn and sorghum, both sown thickly, and in some sections barley or oats. These are among the best paying crops of the western farms, and increase the flow of rich milk in the dairy farms.

Mr. Edward Atkinson, the well-known manufacturer and publicist, is very enthusiastic as to the benefits to be derived, especially on wornout lands, by the system of ensilage. He said, in New York, in May, 1881: "Having seen 120 cattle and twelve horses that had been fed for nearly eight months on the product of thirteen and one half acres of land, with only four quarts per day of very ordinary middlings, I think it becomes rather difficult to limit one's conception as to what this new force may do in restoring exhausted soils, or developing power of production in places that have not yet been touched. The need of the south is succulent food in the long, hot, dry summer that makes the great cotton crop; the need of the east is succulent food during the long winter when pasture is not to be had. Both are supplied by ensilage." Mr. Atkinson prefers Mills' method to that of the French agriculturists.

### THE CULTURE OF FRUIT.

The first apples raised in this country were probably from trees planted on Governor's Island, in Boston harbor, from which, on the 10th of Oct., 1639, "ten fair pippins were brought, there being not apple or pear tree planted in any part of the country but upon that island." This may have been true of the apple trees, but we think some of the pear trees planted by the Dutch Governors of New Amsterdam in their "boweries" or farms in what is now the lower part of New York City were of somewhat earlier date than this. Some of these venerable pear trees have existed till our own times.

Governor Endicott had on his farm in Salem (now in Danvers, Mass.), in 1640, the first nursery of young fruit trees ever planted in this country. It is related that he sold 500 apple trees for 250 acres of land, or at the rate of two trees for an acre.

Choice fruit was exceedingly rare, indeed hardly to be found at all, in this country, for 160 years after this first nursery was established. There were apple trees grown from seedlings, but unfit for eating, and only used for making cider (any kind of apples, it was said, were good enough to make cider). It has been stated on good authority, that at the close of the Revolution, or even at the close of the last century, there were not, including the Dutch pear trees of New York City and their descendants, as many and as good varieties of choice fruit trees in the whole country as could now be found in a single good farming town of New England or New York. Most of the choice varieties of apples and pears have originated here, or been brought from Europe during the present century. If any very superior apple had existed in any country town in the last century it could not have become known and appreciated, however great its merits, since there was little or no communication between towns even twenty miles apart.

A young man might set out trees if he chose, but for a man of middle age or an old man to do so was absurd, and really tempting Providence.

Nevertheless, during the first quarter of the present century, there were many large orchards planted in various parts of the country, though still with special reference to the production of cider. The fruit from these orchards, though not good as judged by present standards, was much better than that which had preceded it.

The census of 1830 was the first which gave any statistics of fruit or orchard products. The amount was not large, but in 1840 it had increased to $7,256,904, of which cider and apple brandy and perry or pear brandy were the largest items. In 1850, the amount reported was $7,723,186, an increase of less than half a million dollars, but the proportion of cider, perry, and apple brandy was much smaller and of fruit much larger. In 1860, the orchard products had risen to $19,991,885, to which should be added about $8,000,000, nearly one-half of the market-garden products, consisting of small fruits. Between 1860 and 1870 the wine from the California vineyards and from other American vineyards began to come into the market in considerable quantities, and the increased railroad facilities brought great quantities of fruits into market. In 1870, orchard products were stated to be $47,335,189, to which was to be added over five millions for American wines, and ten millions for the small fruits reported under "Market-gardens," making a total of over 62 million dollars for fruit products in 1869–70.

We have not as yet the census report of the fruit crop of 1879–80, which shows an immense advance in the production and export of fruits, but a very elaborate article on fruit culture in the Agricultural Report of 1878 gives us most of the figures to the close of 1877, together with statistics of the dried, kiln-dried, evaporated, and canned fruits. From this article we find that the fruit crop of 1877, though not what was called a "bearing year," was, in round numbers, $138,216,700, to which is to be added $30,000,000 for the wine crop, making $168,216,700. Besides this large sum, the dried, evaporated, and canned fruits aggregated in that year over $17,000,000, and have since greatly increased. The Eastern markets, within the last two years, have been largely supplied with California pears, quinces, nectarines, figs, raisins, and grapes, of choice varieties, ripe and fresh, at very low prices. The Florida orange groves are just coming into full bearing, and the supply of these delicious fruits is very great, though not equal to the demand. We export about $3,000,000 worth of ripe and canned fruits every year, and the export demand is increasing.

The quality of the fruit of all kinds has been greatly improved through the exertions of horticultural and pomological societies. The oldest of these was founded in 1829. The American Pomological Society was organized in 1848. There are now societies having the same objects in view in nearly every state, and almost every county and town in the Northern and Western States, and in many of the Southern States. They have encouraged in every way the production of new and valuable varieties of fruit, have thrown much light on the best methods of propagating, cultivating, and marketing fruit of all kinds. They have introduced many new varieties of apples, pears, grapes, plums, and strawberries from abroad, and have by careful selection produced native fruits from seedlings and by hybridization, which surpass most of the European species and varieties. About 150 varieties of apples have been largely cultivated, most of them of fair promise, and all of them superior to the best in the country in 1820. Of these, perhaps, 25 are foreign, mostly from the north of Europe and Asia, and very hardy. A few of these are really very excellent autumnal and winter apples, such as the Red Astrachan, and other Russian and Siberian fruits—as well as some from Northern China and Japan. But the best apples we have are indigenous varieties, some of them seedlings, others produced by hybridization. The Rhode Island Greening, the Newtown, and Golden Pippin, Baldwin, Northern Spy, King Apple, Vanderveer, Baldwin and Prentiss Russet, Seek-no-farther, Gilliflower, Ben Davis, and among the sweet apples, Golden, and Twenty-ounce Sweet, Talman's Sweet, Grimes' Golden, etc.; of the summer apples, Harvest, Golden Bough, Sops of Wine, Wine Sap, etc.; and of the newer kinds, Fameuse, Rome Beauty, Benoni, St. Lawrence, Maiden's Blush, Mother, Rawle's Janet, Oldenburg, Walbridge, Fall Orange, Porter, Dyer, Jonathan, Willow, Striped Pippin, Wealthy, etc., are not surpassed anywhere. The apple crop is the largest of our fruit crops, except the grape, but its money value probably does not exceed that of the peach.

In the cultivation of pears very strenuous efforts were made, at first, to introduce and naturalize French varieties. A few of these did well and are still prized, such as the Duchess D'Angouleme, Louise Bon de Jersey, White Doyenne, Flemish Beauty, Belle Lucrece, and perhaps one or two more, but the greater part proved failures, and to-day a native variety, the Bartlett, stands at the head of all the pears in the market, both in price and excellence, and the Sheldon is perhaps next in rank. Other American pears have an excellent reputation, and the culture of the pear is becoming more general.

The peach crop in this country in a favorable year is valued at nearly 60 million dollars. It cannot be regarded as a certain crop above the 43d parallel, and on the eastern coast not above the 42d. On the Pacific slope it may do well in ordinary years up to 45°. In the South it can be cultivated with great success. It is cultivated to some extent throughout the country below the 43d parallel, but the great peach orchards which supply the market are in the eastern shore of Virginia, in Maryland, Delaware, New Jersey, and Eastern Pennsylvania, on the lower Hudson, and in southwestern Michigan and Illinois. There are many varieties, a few clingstones, though generally freestones, but the great cultivators devote their attention principally to five or six kinds—about equally divided between the white and yellow varieties. The peach is not a long-lived tree, usually dying out in eight or ten years. The earliest peaches come from Florida and Georgia, where they are grown largely, but not of the best qualities.

The next of our large fruits in the extent of its culture is the orange. The culture of this excellent fruit is confined to the extreme South, Florida, Southern Georgia, Alabama, and Mississippi, Louisiana, and the coast region of Texas, Southern Arizona, where it is not too dry, and Southern California. Some species might succeed in New Mexico, but it is not now cultivated there to any great extent. The culture is somewhat difficult, and there is occasionally liability to killing frosts, and a delay of ten years at least before the crop is sufficiently large to be profitable, but after that time the yield constantly increases, and produces a large profit. The Florida oranges are reputed the best grown anywhere, and the demand constantly exceeds the supply. The oranges of California are of different varieties, and possibly

MAKING READY FOR CULTIVATION.

CULTIVATION OF SMALL FRUITS.

GATHERING HOPS.

of different species from those of Florida, but are of excellent quality. The culture of the orange has only attained any considerable magnitude in the value of the crop within the past decade (1870–1880), but is rapidly increasing. The orange crop in 1877 was valued at $16,000,000. It is safe to say that it has doubled since that time. Of the other larger fruits growing on trees, as quinces, nectarines, apricots, plums, prunes (the culture of which has only recently commenced, but is making rapid progress), figs, lemons, limes, pomegranates, and cherries, the crops, though of considerable size in some sections of the country, and most of them increasing, cannot well be stated separately, as both in the National and State returns they are only presented grouped together. Any estimate of their aggregate value must be mere guess work, but taking the whole country together, it can hardly fall below twenty million dollars.

The cultivation of small fruits is a matter more easily tabulated and described because the movement of these crops is on a large scale, and generally occupies a few weeks only. The grape crop is the largest of these, including as it does not only the green and ripe grapes, but the wine product, and the raisin production, which is now attaining considerable magnitude in Southern California. None of the foreign species or varieties of the grape, and only a very few of the native species, and those mainly the wild grapes of the Labrusca, or Fox grape family, can be grown above the parallel of 45° east of the Rocky Mountains; all, or nearly all, the cultivated varieties requiring a period of at least three months, when the average temperature does not fall below 67° F., to fully ripen the berries. East of the Mississippi river the practical limit of certainty is not higher than 43° or 43° 30′.

Most of the foreign varieties succeed well in California, Texas, and Florida, but have failed elsewhere, except under shelter, and with some artificial heat. Some of the hybrids produced by crossing these with our native grapes have proved of excellent quality, and some of our native grapes are found to be of admirable character, especially for wine-making purposes. The Catawba, Delaware, Concord, Isabella, Maxatawney, and Diana, among our northern grapes, are of fair quality, and though hardly to be classed very high as table grapes, make good wines, and some of the hybrids from these, as the Iona, Walter, Roger's Hybrids, some of Rickett's and Miner's Seedlings, the Brighton, Hartford Prolific, Cottage, Telegraph, Warden, Cambridge, Black Hawk, and Lady, and of the newer varieties (all hybrids), the Duchess, Niagara, Prentiss, and Pocklington, are of approved quality for the table.

Among the Southern native grapes, which belong to the Summer grape (*Vitis Aestivalis*) family, there are some of great merit. Among these are the Lenoir, Herbemont, Devereaux, Alvey, Neosho, Cynthiana, Norton's Virginia Seedling, the Scuppernong, and the Post Oak. From these there are many seedlings and hybrids of rare excellence. Among these may be named the Hermann, White Hermann, the Taylor, Elvira, Amber, and Pearl—all of them excellent, both for wine making and as table grapes. Most of these are believed to be proof against the *phylloxera*, or grape pest.

The foreign varieties have generally done well in California, and some of them in Florida and Texas. California has a native grape, or one naturalized so long since that it is generally considered native—the Mission grape—which possesses great merits, though with some defects. It was probably originally a Spanish grape, introduced by the Jesuit Missionary Fathers, and in the strong and rich soil of California has taken on a new character. The wines from this grape, though having a very slight and hardly perceptible earthy flavor, are yet, when rightly made, and of sufficient age, among the best of American wines. But every variety of grape having a good reputation in Europe is grown successfully in California, both for the table and for wine, and many of them for raisins. All these grapes in the clear, dry, hot sun of California make more sugar than in Europe, and the wines made from them are stronger in alcohol than the European wines, while still retaining a very perceptible amount of unchanged sugar. For table use and for raisins many of these grapes surpass those raised in Europe. The Tokay, and Muscat, the Malaga, and many other grapes produced there are much finer than can be found in Europe. The "Raisin of the Sun," from California vines, will soon surpass the best

Smyrna raisins. The value of the grape crop, as grapes, wine, and raisins, now exceeds 60 million dollars, and it is increasing with great rapidity. California alone has over 200 millions of vines, and Missouri, Ohio, Southern Michigan, Central and Eastern New York, New Jersey, Delaware, Maryland, and Virginia, and North Carolina, all have extensive districts of vineyards, in which the grape is cultivated both for the table and for wine. Aside from this, south of the 42d parallel almost every farm and town residence raise grapes enough for the use of the occupants.

The STRAWBERRY is next in importance to the grape among the small fruits. The strawberry is essentially an American fruit, native to our soil, and, though extensively cultivated now in Europe, is nowhere brought to the perfection it has attained here. Prior to 1830, all the strawberries consumed grew wild in the fields, and as late as 1840 the attempts at cultivation were only the efforts of farmers and gardeners to produce this delicious fruit in greater abundance where it would be more under their own control. The idea of the hybridization of the strawberry for the purpose of increasing its size and good qualities, and of putting the improved fruit upon the market, if it did not originate with the late A. J. Downing, was first extensively attempted by him, and he had soon a host of imitators. The size of the berry has been enormously increased, sometimes with a sacrifice of some of the flavor, sometimes with a development of too great acidity, and sometimes with a diminution of its keeping qualities. A few varieties combine several excellences. The Wilson, the most popular berry with the marketmen of large cities, on account of its keeping well, is a very sour and poor berry for eating. The Charles Downing is much better, and should be more widely cultivated. The Jucunda, the Tribune, the Lincoln, and a foreign variety, the Triomphe de Gand, are also good and large strawberries. and profitable for growers. Boyden's No. 30, the Sharpless, Glossy Cone, Great American, Black Giant, Beauty, Pioneer, and Gypsy, are the most popular of the later varieties. Most of them are very large. The best strawberry brought into the New York market is a small bright red berry, half wild, grown on the Hackensack plains; its flavor is exquisite. The strawberry crop in 1877 was estimated at $5,000,000; there is reason to believe this was an underestimate. The increase has been very great in the past three years, both in the sales in smaller cities and villages, and for the purpose of drying or evaporating and canning. The sales in the season of 1880 could hardly have been less than $8,500,000, and with a better berry than the Wilson as the leading variety, they would very speedily reach 10 millions.

Of the other small fruits of the summer, raspberries, yellow and red, and the black caps of several varieties, are most largely cultivated, though these also grow wild There are a number of varieties, such as the Hudson River, Antwerp, and Brinckle's Orange of the yellow, Philadelphia, Highland Hardy, and Cuthbert, of the red, and Doolittle and Gregg of the black caps, but the sales, though increasing, bear but a small proportion to those of the strawberry

The blackberry, of several varieties, both native and cultivated, is becoming a favorite berry for midsummer. The wild berries are the sweetest and best flavored.

The currant and gooseberry are sold in all our markets, but only in moderate quantities.

The cranberry is an autumnal and winter fruit, and one whose culture is increasing, and which brings a uniformly high price. The crop over the whole country in 1877 was estimated at 400,828 bushels, and at the average price then prevailing, it was worth over a million dollars. The crop of 1878 was not quite so large; those of 1879 and 1880 were thought to have been even larger. The supply is seldom equal to the demand. The cultivation of the cranberry, though somewhat difficult at first, is very easy when once established, though the largest part of the crop is grown wild in the marshes of New Jersey, Michigan, and Wisconsin.

We have already alluded to the different methods of preserving these fruits for use through the year. Formerly there were two of these, both conducted only in the household, preserving in sugar syrup, and drying in the sun, or in the house in winter. The preserving process is now very little practiced, canning and sealing hermetically having taken its place. Canning is now conducted on a very large scale in immense factories, and has been extended to almost all kinds of vegetables, as well as fruits, to meats, fish, oysters, etc. The entire products of the canning trade are not less than 120 million dollars, of which not more than one-third are fruits. Considerable quantities of fruit are also put up in private families, mostly in glass jars. Apples, peaches, plums, and many of the small fruits, are also prepared for the market dried by three processes—the old practice of drying in the sun, kiln-drying, and evaporating. The last process is much the best, and the fruits prepared by it command high prices. It can only be conducted in a house constructed expressly for it, a double tower, 80 to 100 feet high, in which the open-work trays rise to the top of one tower and descend on the other, subjected all the time to a moist heat, with the evaporation of the fruits to dryness in an atmosphere charged with their juices. The elevating power may be a horse-power, or a small steam engine. The fruits thus evaporated are very white and clean, and retain their special flavors. The dried fruit sales amount in favorable years to about ten millións of dollars.

The trade in nuts, etc., is a constantly increasing one. The peanut, groundnut, or groober, is not, in one sense, a nut at all, but rather a member of the bulbous family. These are raised mainly in Tennessee and Virginia, though New Jersey, Maryland, North Carolina, and Kansas raise a considerable quantity. The whole crop is about 2 million bushels, and the average price a dollar a bushel. Of the other native nuts, hickory nuts, often called white walnuts, and pecan nuts, are most largely sold, though butternuts, black walnuts, chestnuts, and hazel nuts, are sold to a considerable extent. Filberts (mostly imported), English walnuts, or Madeira nuts, Brazil nuts, etc., are imported freely, and some English walnuts and Italian chestnuts are beginning to come in from California. The pecan is the finest and most profitable of our native nuts. The sales of native nuts amount to about $2,500,000, and we export nearly a million dollars' worth.

The great development of fruit culture in the United States within the past forty years has led to the publication of a great number of works on the cultivation of fruits, and to the establishment of numerous periodicals devoted to that specialty. As lately as 1845 there was but one of these periodicals; now there are at least one hundred, and the books on the subject are numbered by scores. The agricultural and horticultural exhibitions now held yearly in almost every county, and very many towns of the Northern and Middle States, have given a great impulse to fruit growing, and orchards and vineyards of choice fruit are becoming the rule instead of the exception on northern farms. To a certain extent, especially in the higher lands, this is becoming true also in the South, and still more so in the West.

From the progress in the cultivation of fruits, which has been styled by some the poetry of farming, let us turn to the

### CULTURE OF TOBACCO.

Whether tobacco is to be regarded as a bane or a blessing, it must be acknowledged that it is a native of this continent; and though many efforts have been made to naturalize it in Europe, only one of its six or more species (*Nicotiana rustica*), has proved successful there. The Indians, both on the West India Islands, and on the Continent, had used it for smoking purposes many years before the discovery by Columbus. It has been truly remarked that every country or tribe of human beings has had, from time immemorial, its own peculiar narcotic, either aboriginal or imported, and that the universal instinct of the human race has led, somehow or other, to the universal supply of this want or craving; as, for instance, tobacco in America, and its islands; the thorn apple, coca, tobacco, and hemp in South America; hops and tobacco in Europe; hemp in Africa; aminita, opium, betel-nut, and tobacco in Asia; showing that it is natural for man, after supplying the necessities of life by food, to desire to multiply his enjoyments, intellectual and animal, and, for the time, to exalt them; and we cannot ascribe so universal a habit, increasing with the growth of population, to mere whim or fancy for self-indulgence. It is, perhaps, a necessity imposed by nature, and second only to that greater necessity, the satisfaction of the craving of hunger.

Certainly, the extent to which it is cultivated, occupying so large a proportion of the best arable lands of some countries, which are equally adapted to wheat; its great importance in a commercial point of view, and the variety of ways in which it is employed to gratify the senses, present a striking feature in the history of the human race.

"Thy quiet spirit lulls the lab'ring brain,
Lures back to thought the flights of vacant mirth,
Consoles the mourner, soothes the couch of pain,
And breathes contentment round the humble hearth;
While savage warriors, soften'd by thy breath,
Unbind the captive hate had doomed to death."

It has steadily pushed its way in the face of every opposition which ridicule, prejudice, legislative prohibition, threats of excommunication, and every conceivable persecution could bring against it, simply because nature demanded its use in some form or other. The celebrated Locke took a more rational view, and said, "Bread or tobacco may be neglected, but reason at first recommends their trial, and custom makes them pleasant." But, on the other hand, "the most high and mightie prince," James I., by the grace of God king of Great Britain, "a slave to vices which could not fail to make him an object of disgust," took a different view of the prevalent practice, and wrote a "Counterblaste to Tobacco," stigmatizing its use as "A custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black, stinking fume thereof, nearest resembling the horrible Stygian smoke of the pit that is bottomless." Everything which is really and truly founded in nature and reason, however mysteriously, will ultimately prevail, whoever sets himself up to oppose it; and the progress of the culture and use of this plant is an instance of it. King James wrote in 1616, and in 1624 Pope Urban VIII. published a decree of excommunication against all in the church who took snuff; and in 1634 smoking tobacco was prohibited in Russia under penalty of having the nose cut off; and in Transylvania the penalty for growing this plant was a confiscation of the farmer's whole property; and even so recently as 1719 the Senate of Strasburg forbade the cultivation of it, from the fear of its diminishing the culture of corn. But "they manage things better in France," and the far-sighted Richelieu imposed upon it a duty, very small at first, which continued till 1674, when the government of Louis XIV. increased the duty and made the culture and trade in tobacco a monopoly, and granted it to an individual for six years, in consid- of the payment to the government of the large sum of $145,000. In 1720 the consideration was increased more than 100 per cent., and in 1771 it amounted to $5,-500,000 a year. In 1844 the revenue from tobacco alone yielded the French government the enormous sum of $20,000-000, and it has since increased till it now amounts to 300 million francs, 60 million dollars, annually. So much for Richelieu; and it must be admitted, even by the most prejudiced opponents of tobacco, that this policy was more sensible than that of his neighbors who mutilated, and some of them cut off the heads of all smokers.

The English first saw it cultivated, and smoked in clay pipes, by the Indians of Virginia, in 1585, and it was probably introduced into England by Raleigh, as early as 1586. In 1615, the gardens, fields, and streets of Jamestown, Virginia, were planted with tobacco, and it became not only the great staple, but, according to Bancroft, the chief currency of the colony, and in 1622 the product was 60,000 pounds. During the next twenty years it doubled, and amounted to 120,000 pounds, and since 1689 the product of Virginia alone has increased to twice as many milllons of pounds.

The introduction of tobacco culture into the Dutch colony of New York took place as early as 1646, and it sold then at forty cents a pound. The "Company of the West" introduced it into Louisiana in 1718. Previous to the revolutionary war its culture had extended into Maryland, the Carolinas, Georgia, and Louisiana, and nearly all Europe was, at that time, supplied from the American colonies. Since that time the cultivation has greatly extended in this country, not only into new states and territories, but in the aggregate amount raised. The quantity exported has also very largely increased. The amount of the tobacco tax or revenue in Great Britain in 1880 was about 43 million dollars, the duty averaging about 75 cents a pound.

The annual export from the colonies for ten years previous to 1709 was 28,868,666 pounds. From 1744 to 1776 the exports of tobacco averaged 40,000,000 pounds a year. The tobacco exported from Virginia in 1758 is said to have been no less than 75,000 hogsheads, and from that time till the Revolution, the amount averaged 55,-000 hogsheads a year. About 30,000 hogsheads were shipped from City Point, in Virginia, in 1791, and in 1795 the amount fell to 9,475 hogsheads. There were exported from North Carolina 100 hogsheads in 1753, while from Georgia, in 1722, there were shipped 176,732 hogsheads. South Carolina exported 2,680 hogsheads in 1783, and 4,294 in 1795. The quantity exported from Philadelphia in 1796 was 3,437 hogsheads.

According to the census of 1840, the amount raised in the United States was 219,163,319 pounds. The census of 1850 returned but 199,752,655 pounds, showing a decrease of 19,410,664 pounds. The census of 1860 returned 434,209,461 pounds. The crop of 1869-70 was based on a bad year, but was greatly misreported in the census, as it actually reached about 390,000,000 pounds. In 1879, the crop was estimated at 391,278,350 pounds, but this was much below the truth. That of 1877 was 580,000,000 pounds. The crop is liable to many casualties—to damage by insects, hail, drought, frosts, or an otherwise bad season at harvesting. So great is the demand for home consumption and for foreign exportation, that the profits of tobacco are usually very great, operating as a constant stimulus to a more extended culture.

Of the amount returned by the census of 1860, Virginia raised 123,968,312 pounds, and Kentucky 108,126,840 pounds, making, together, more than half of all that was raised in the United States. But for fifteen years past the use of guano has become more extensive than it was previously, and the yield of this ravenous crop on lands said to have become exhausted from long-continued culture, has been greatly enlarged in consequence. Its cultivation has, also, been extending northward, and the produce of Connecticut and Massachusetts, in 1870, was 15,640,281 pounds, and in 1879 was estimated at 14,010,000, of which, however, Connecticut was credited with 9,660,000 pounds. Kentucky, Virginia, Tennessee, Pennsylvania, Maryland, Missouri, and Ohio, were the only other states of large production in 1880.

Tobacco is usually called an exhausting crop. This depends very much upon the kind and quantity of manure used. If the mineral constituents taken from the soil, and represented in the ash of the plant, are supplied by judicious cultivation, there is little difficulty in cultivating and producing large crops, and it is a common remark of the best farmers along the Connecticut river, that wheat or any other crop will follow tobacco, even better than most other crops, for the reason that the high manuring for tobacco keeps the land in good heart. But the planters in Virginia cultivated it for many years in succession on the same lands, without supplying a sufficiency of manure. The land, of course, must feel the loss in time, and the yield, previous to the introduction of guano, had dwindled down in many localities so as not to pay the producer. Every ton of tobacco, perfectly dried, carries off some three or four hundred weight of these most important mineral substances, and it should be the aim of the farmer to supply them liberally, if he expects a liberal reward in an abundant harvest.

The geographical distribution of the tobacco crop of 1860, which was perhaps a fair average of the annual crop at present, was as follows: The south raised 242,077,957 pounds, valued at $36,311,663. The west raised 173,758,787 pounds, valued at $25,952,718. The north raised 18,362,098 pounds, valued at $2,754,314.

In this connection, it would be a matter of no small interest to ascertain, if possible, the number of hands employed in the cultivation, curing, and manufacture of tobacco in the U. S. According to the census of 1870 the number employed in its cultivation was 59,224, and possibly half as many more in stripping and curing, while 95,696 persons were engaged in the manufacture; making about 185,000 in all. The number has largely increased since that time. In the city of Hamburg (Germany) alone, this manufacture gives employment to upward of 10,000 persons, and it supplies 150,000,000 cigars a year, with a value of $2,000,000—a matter of no small importance. Hamburg imports from Havanna and Manilla about 18,000,000 cigars a year; and, with its own production, the aggregate number is 168,000,000 cigars. 153,000,000 of these are exported, and the remainder, or 15,000,000, are consumed in that city; giving 40,000 as the daily consumption, in a population of 45,000 male adults. The consumption of tobacco in England in 1821, with a population of 21,282,960, was no less than 15,598,152 pounds, or 12 ounces per head of the entire population. In 1831, with a population of 24,410,439, the consumption reached 19,533,841 pounds, or 13 ounces per head. In 1841, with a population of 27,019,672, the consumption was 22,309,360 pounds, or 13½ ounces per head. And in 1861, population estimated as 34,-500,000, the consumption was 75,099,427 pounds, or 20⅓ ounces per head. About one-third of this is snuff. In France the consumption amounts to 28½ ounces per head, nearly half of which is in the form of snuff. The crop in France amounted, in 1879, to about 20 million pounds, and the importation to more than 60 million pounds, of which nearly 45 millions were from the United States. The net revenue to the French Government in 1879 was about 67 million dollars. The *Regie*, or Government Agency imports hardly anything except leaf tobacco, and about half of the entire consumption is from the United States. We send to France about one-tenth of our crop, and in 1879 realized from our export thither $2,572,000. The consumption per head in France is about 28½ ounces, in Paris about 56 ounces. Our export to Great Britain in 1879 was over 65 million pounds, and the net value $8,141,113. The great bulk of her importation is leaf tobacco, but she takes about a million of dollars of the manufactured forms.

Germany is our largest customer, taking in 1879, of leaf tobacco, 112,098,952 pounds valued with a small quantity of manufactured tobacco at $8,191,816. The consumption of tobacco in Germany is about 53 ounces per head. We send about 27 million pounds, valved at $2,150,000. The kingdom raises about 10 million pounds, but its annual consumption is about 47,000,-000 pounds, or about 21 ounces per head.

The Netherlands took 22,516,818 pounds in 1879 besides some manufactured tobacco. They raise a moderate quantity and buy of Turkey and Hungary. Their consumption averages 71 ounces per head. Belgium takes tobacco from us to the value of a million dollars, of which the greater part (15,698,139 pounds) was leaf tobacco. Belgium raises what tobacco she can, and buys unmanufactured tobacco from all sources though more largely from us than from any other nation, but her consumption per head—88 ounces—exceeds that of any nation in the world. Spain takes 11,500,000 pounds from us, aside from all she receives from Cuba, South America and Mexico—but her consumption is moderate, only 17¼ ounces per head. About 13,600,000 pounds go to the British Colonies. Our exports amounted in 1879 to 322,279,540 pounds of leaf and manufactured tobacco in all forms to the value of $3,057,876, making a total value of $28,215,240. This has been about the average value of our exports for the past seven years, though those of 1880 were about ten million dollars less. The real crop of 1879 must have been fully 500 million pounds. The remainder, after the export, must have been worth in its unmanufactured condition not less than $10,000,000, for it paid a revenue tax when manufactured, of $40,000,000. So that this crop and its proceeds for 1879 exceeded $75,000,000.

The most profitable farming, in the long run, is that which combines various kinds of produce, a considerable proportion of which must of necessity be consumed on the farm itself, or at least near home. Where the population is sparse, and there is no demand at home for farm produce, the farmer is compelled to raise such articles as will bear distant transportation, and follow this course year after year. He cannot, if he would, grow the articles which would be the least exhausting to his land. The Virginia tobacco planter of the last century and the early part of the present, had no means of restoring the fertility of his soils by supplying the vast amount of mineral constituents which the constant cropping and removal by transportation took away from his farm. He could not, or would not keep much stock to supply sufficient manure; and if he kept stock, the winters were mild, and they were never housed and so managed as to produce much manure. Cattle allowed constantly to run at large, and browse in the woods summer and winter, would do little to prevent the deterioration of the soil. It would have been better for the land if the planter had been obliged to cultivate and cut grasses for winter fodder, and then keep up his stock to consume it. The Belgian proverb is everywhere true: "No grass, no cattle; no cattle, no manure; no manure, no crops." The worst effect of a system of exchange of agricultural products with other nations, by which we receive their manufactured goods, which possess great value in proportion to their bulk and the raw material consumed in them. is that we send off annually to them thousands of tons of the highest fertilizing elements, which nature requires should be again returned to the land in the form of manure. But we are sending off $288,000,000 worth of breadstuffs, 212 million dollars worth of cotton, and 35 million dollars worth of tobacco and other exhausting crops, which take from the soil the elements indispensable to its fertility, and we make no adequate return of fertilizers to it.

Other nations, like England, for instance, importing 200 millions worth of breadstuffs, have the benefit of their consumption, in addition to which they are constantly importing manures of every description. While we are constantly, and without stint, shipping off a continual stream of the most valuable manures concentrated in the form of our cotton, our tobacco, our wheat, and Indian corn, they, with ceaseless care, are husbanding the fertility which these naturally carry along with them, and adding vast quantities of guano, bones, phosphates, etc. They reap the harvest in soils growing richer and richer. We may make individual profits, which go, for the most part into the hands of middle men, and leave our farms to reap the shadow.

The inevitable tendency of exchanging the produce of the soil for manufactured articles has always been, and always will be, to impoverish the nation that does it, unless there is care and forethought enough to import an amount of fertilizing substances equal to what we send away; and this cannot be. The farmer himself does not want it so. If he sends wheat enough to half feed a foreign mechanic or operative in the city of Sheffield or Manchester, he would infinitely rather sell him enough to feed him in full nearer home; and it would be better for him and for the nation to have it so.

### CULTURE OF HOPS.

Of the crops which still remain to be mentioned, and which help make up the aggregate of the products of American agriculture, that of the hop forms no unimportant item, since, beside the quantity required for export, which, to be sure is not very large, it enters more or less into the consumption of almost every family in the country.

This plant, like many others, dates its introduction to this country almost back to its first settlement; for we read in the records of the colony of the Massachusetts Bay, that "hop rootes" were ordered by the governor and company as early as 1628 or 1629, and though it was for many years cultivated only on a very limited scale for family consumption, yet no doubt it has continued as one of the cultivated plants of the country from that day to this. It was introduced and cultivated by the Dutch colony of New York as early as 1646, and it is known to have been brought into Virginia previous to 1648. In 1657 its culture was encouraged by legislative enactments.

At the beginning of the present century, the amount cultivated in New England was extremely limited. Thirty thousand pounds, perhaps, comprised the entire crop of that section, increasing some years to fifty thousand. The mode of picking and drying was objectionable and defective. The hops were picked in clusters, with the stems and leaves often thrown in; while the drying was universally done with wood, and when taken from the kiln they were "brown as a leg of bacon, and about as much smoked."

The first use of charcoal for drying hops in this country was probably in 1791, when it was tried, only on a very limited scale, at the suggestion of a Scotch brewer, and produced the most beautiful kiln of hops that had ever been dried in America. It was owing to this improvement in the picking and drying that the demand for the article rapidly increased, soon doubled and tripled, and slips or cuttings to form new plantations soon rose to exorbitant prices. It had been the universal custom, previous to that time, to pack the hops in round bags, without any uniformity in length or size, and they were trodden down with the feet in a rude manner. The consequence was that the tops were bruised and broken, causing great loss in the strength and value of the hops by evaporation of the essential juices of the plant, its most valuable properties, to say nothing of the impossibility of packing closely for transportation. The use of square bales was introduced in 1797, or the year after, and the use of screws in packing was then commenced. The superiority of this mode soon became so apparent, that it was generally adopted not long after. Previous to this time, also, difficulties not unfrequently arose between merchants, from the fact that old and refuse hops were found mixed in with the good ones, while no proper distinction was made between the different grades or qualities. Vexatious lawsuits sometimes resulted from these circumstances, and the price of good hops was naturally lower than it otherwise would have been. The legislature of Massachusetts, to remedy these evils so far as they existed in that section of the country, created the office of inspector-general of hops in the year 1806. It was probably the first movement of the kind in the world.

But there were no precedents for classifying hops, and some system was to be adopted. Some hop dealers and many hop growers were opposed to a high standard of inspection. Many difficulties of a personal nature had to be encountered; but, owing to the conscientious use of the "first-sort" brand, the hops raised in that part of the country soon became noted as the best by far in the United States. By adopting a high standard of inspection, the growers were soon brought to improve their hops, in order to bring them up to the "first sort," and this becoming known in Europe, those who sent orders from there required hops of Massachusetts inspection, which consequently brought a cent or two on a pound more than those of any other state. There has been a remarkable fluctuation in the prices of hops. The average prices per pound for 30 years—1849–79—were, in gold, 41 cents, 32, 28, 34, 20, 7, 8, 7, 13, 15, 19, 25, 20, 17, 22, 22, 42, 45, 45, 15, 25, 12, 60, 55, 40, 48, 15, 28, 13, 15, 30 cents. The production of this crop and its exports have also been exceedingly irregular. The export demand is mainly controlled by the success or failure of the English crop, though there is an increasing demand from Germany and other continental countries. In 1840 the entire crop was 1,238,502 pounds. In 1850 the census report of the production of the preceding year was 3,497,029 pounds. The exports were 1,275,455 pounds. In the following years the crop was small and the exports ranged from 110,000 to 260,000 pounds; in 1855, there was a crop of over 10,000,000 pounds, and 4,021,816 pounds exported; in 1860, 10,991,996 pounds produced, but only 273,257 exported. In 1863 there was a large crop and an export of 8,864,081 pounds—the largest quantity exported in one year up to that time. In 1868 the crop was small and the export only 532,038 pounds. The crop of 1869 (census of 1870) was 25,456,669 pounds, and the export 16,356,231 pounds. The years which followed were disastrous, and the exports dwindled from 3,273,653 in 1871 to 117,358 pounds in 1874. Then they began to rise, till in 1877 the crop was over 39,000,000 pounds and the export 18,458,782 pounds. The quality of this great crop was not equal to the quantity, and the value of the export—$2,152,873—was less than that of the previous year, when the export was but 9,581,108 pounds, or little more than half. The crop of 1879 was nearly 32,000,000 pounds, and the exports to June 30, 1880, were 9,739,566, but the quality was excellent and the value of the exports was $2,573,292, which would indicate the value of the entire crop as something more than $9,000,000. The crop is very uncertain, but taking the years together it proves moderately profitable, though very exhausting to the land. The cost of producing a pound of hops in the best managed hop yards averages about 10½ cents. In England, the Kentish hop-growers compute it at about 22 cents. New York takes the lead in this crop, producing two-thirds of the whole. Wisconsin follows, contributing about one-fifth. New England together yields about a million pounds, and Michigan and California nearly as much. None of the other states are largely engaged in its cultivation.

### CULTURE OF FLAX AND HEMP.

Like most of the crops already mentioned, both flax and hemp were introduced into the colonies very soon after the settlement of the country. Flax was taken to Holland from the Dutch settlement at Manhattan Island, or New York, as early as 1626. The governor and company of the Massachusetts Bay, in New England, also ordered both flax and hemp seed in 1628, if not, indeed, as was probably the case, at an earlier date. Hemp was very soon abandoned, as the land was not found strong enough for it.

Hemp and flax was raised in Virginia prior to the year 1648, as we read of their being woven and spun there; and bounties were offered for the culture of hemp in 1651, and of flax in 1657; but the culture fell off as soon as the bounties were discontinued.

But flax was pretty generally cultivated in small quantities for home consumption, in most parts of the country. It was not only raised, but manufactured, at home, and formed a most important article in the domestic economy of the days of home-spun. In 1745, some Irish emigrants arrived in Massachusetts, and established an improved mode of manufacturing linen and other "spinning work," and they met with some success. Manufactories were established in Salem, Mass., for making sail-cloth, as early as 1790.

In 1751, no less than 14,000 pounds of hemp were exported from New Jersey, and the next year, 1752, the amount of flax-seed exported from Philadelphia was 70,-000 bushels. The amount rose, in 1767, to 84,658 bushels; and in 1771 to 110,412 bushels. New York exported 12,528 hogsheads of this seed in the year 1755. The total amount exported from the American colonies in 1770 was 312,612 bushels.

In 1791 the United States exported 292,460 bushels of flax-seed; in 1800 the export was 289,684 bushels, and 240,579 bushels in 1810. The culture of these crops grew up more rapidly at the west, and extensive factories were established for the manufacture of cordage, bagging, etc., in Louisville, Lexington, Frankfort, and other places in Kentucky, as early as 1810.

According to the census of 1840, about 97,251 tons of flax and hemp were raised. In 1850 the two products were returned separately as 34,871 tons of hemp, 7,709,-676 pounds of flax, and 562,312 bushels of flaxseed. In 1860 the production of hemp had more than doubled, 73,493 tons being reported; but flax had fallen off nearly one-half, only 4,720,145 pounds being produced, and flaxseed had remained nearly stationary, 566,867 bushels being reported. The great obstacle to flax culture was the want of some simple and effective machinery for scutching and breaking it. Early in the war the demand for flax-tow, and for linseed oil and cakes, and the invention of several flax-brakes, led to a great increase in this crop. This impulse had not subsided fully in 1870, for in 1869–70, 12,746 tons of hemp (about one-half of our present importation), was produced, and 12,113 tons of flax, about three times our importation, was grown, besides 1,730,444 bushels of flaxseed. The production of flax in this country is now mostly for the seed for linseed oil—the land for this being sown thinly, not over half a bushel to the acre, and the fiber, which is of inferior character, being only an incidental product. Some states, as Michigan, Wisconsin, and Oregon, are turning their attention to raising it for the fibre. The production of seed now exceeds 5 million bushels. The amount of lint is uncertain, but may reach 12,000 tons of all qualities. Hemp is more largely cultivated than formerly, but we import annually about 27 millions of flax and hemp products.

### THE CULTURE OF SILK.

The cultivation of silk has never been extensively carried on in this country, though introduced at a very early date—as early, in fact, as the first settlement of Virginia. James I. showed a desire to favor this branch of industry, equalled only by his antipathy to the growth of tobacco. It did not succeed at first, however, and in 1651 another spasmodic effort was made to revive it, but it was to little effect, and it never prospered there.

Silk culture was commenced in Louisiana by the Company of the West, in 1718. It was introduced into Georgia in 1732. A special act of Parliament was required to keep up the interest in it, in 1749, exempting the producer from paying duties, etc.

Connecticut began the raising of silk in 1760, and in 1783 the legislature of that state passed an act, granting a bounty on mulberry trees and the production of silk.

Even under the encouragement of the government, all the raw silk Georgia could export in 1750 was 118 pounds; in 1765 it was only 138 pounds; in 1770, 290 pounds. The census of 1840 returned the amount of silk cocoons at 61,552 pounds; and this quantity had fallen off in 1850 to 10,843 pounds. In 1860 only 11,944 pounds of cocoons were reported; and in 1870, only 3,937 pounds were reported by the census. During the six years following great efforts were made to encourage the rearing of silk worms and the production of raw or reeled silk in California, Kansas, and some other states, but these efforts proved ineffectual. A considerable amount of silk worms' eggs were produced and mostly shipped to France, but the ventures soon ceased to be profitable. The large silk manufacture now established in this country would furnish a good market for all the silk which could be produced here if it could be of good quality and well reeled; but this requires care, skill and experience, as well as cheap labor. An association has recently been formed in Philadelphia to aid silk-growers in producing a good article.

### BEE CULTURE.

The production of honey and the management of bees receives comparatively little attention in this country. So little, indeed, as hardly to be worthy of mention among the products of our national agriculture; and yet they form an important item in the domestic economy of many a household, and ought to receive all the attention they deserve.

The amount of beeswax and honey returned by the census of 1850 was 14,853,790 pounds. In 1860, 1,322,787 pounds of wax and 23,366,357 pounds of honey were produced, an increase of 70 per cent. In 1870 there had been some falling off from this amount, or the census report was incomplete, which is not unlikely. 631,129 pounds of wax and 14,702,815 pounds of honey was all that was reported. Since 1870 the production, though fluctuating, has materially increased, especially in the Western and Pacific States. California, besides supplying the home demand exports, from 3½ to 4 million pounds of honey every year, and the states on the plains—Kansas, Nebraska, &c., produce very largely. The export of honey and wax in 1880 was about $200,000, a little more than the previous year, but considerably less than in 1872. The honey product is believed to be over 30 million pounds.

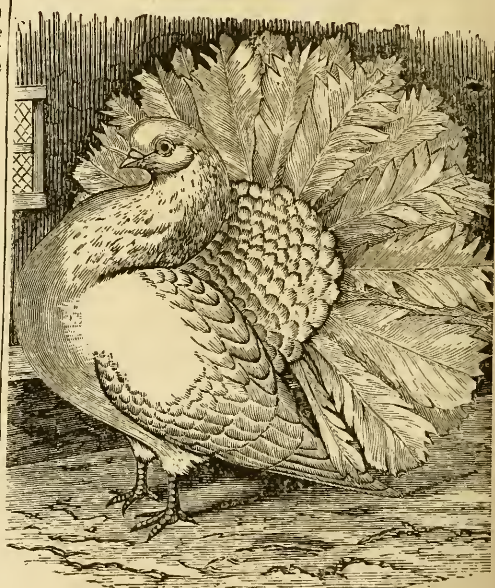
### POULTRY AND EGGS.

The value of the poultry kept in the United States, and the production of eggs, constitutes a much larger item of our agricultural economy than is generally supposed. The value of poultry, according to the census of 1840, was no less than $12,176,170. This sum, great as it appears, has been increased to over 108 millions of dollars. The city of New York alone, pays about ten millions of dollars a year for eggs. And so the other large cities require a supply in proportion.

The keeping of poultry, therefore, is by no means an insignificant item in the products of our agriculture, though for some reason or other the censuses of 1850, 1860, and 1870 failed to take cognizance of it.

It is doubtful whether the introduction of foreign varieties of fowls effected an improvement in the common stock of the country. The number of fowls was increased, but the product of eggs, was not, materially.

Within the decades 1860–1880, great attention has been paid to poultry farming on a large scale. The fowls, including hens, turkeys, geese, ducks, and guinea fowls, are kept in large numbers, hatched artificially, stimulated to lay by suitable food, and fattened scientifically for market, to which they are sent at the proper season, carefully packed. Ohio and New York have many of these chicken factories.



FANTAIL PIGEON.

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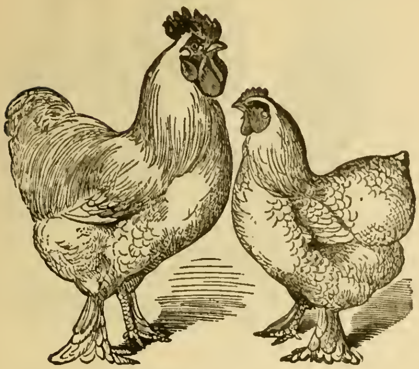
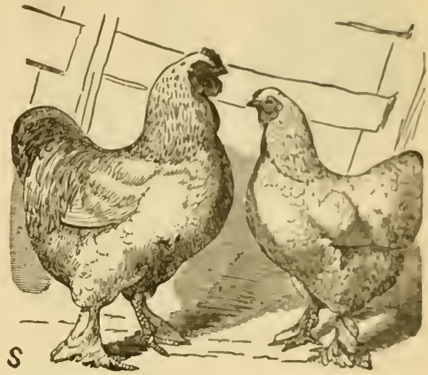
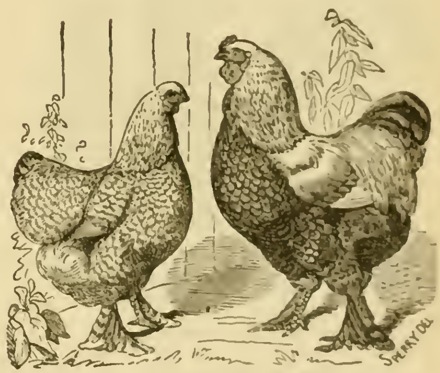


WHITE COCHINS.

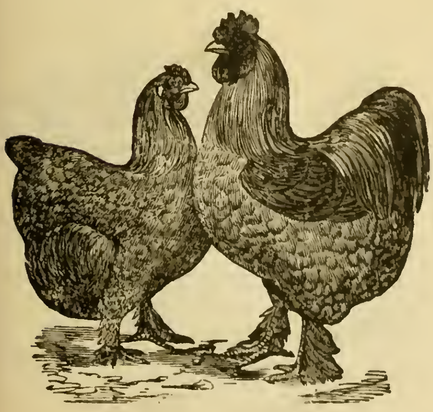


LIGHT BRAHMAS.

BLACK HAMBURGS.

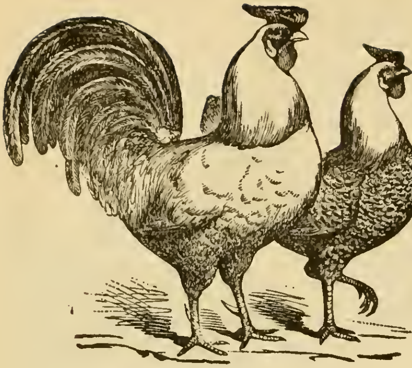


DARK BRAHMAS.



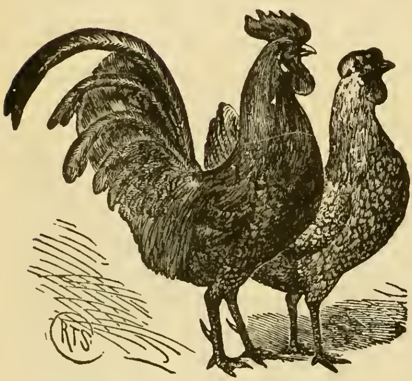
BUFF COCHINS.

PARTRIDGE COCHINS.

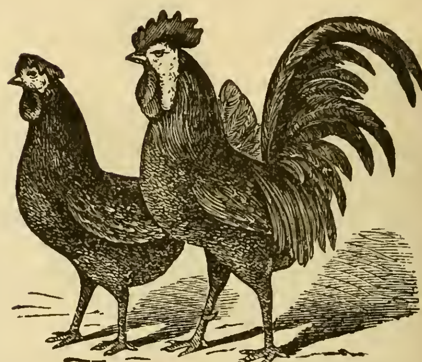


S. P. HAMBURGS.

WHITE LEGHORNS.

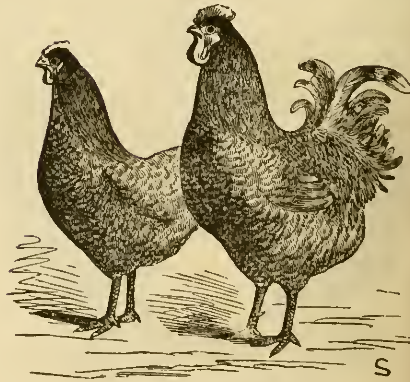


BROWN LEGHORNS.

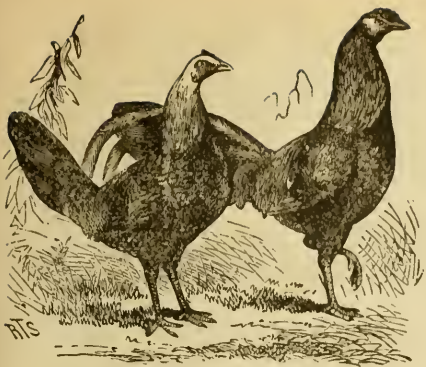


BLACK SPANISH.

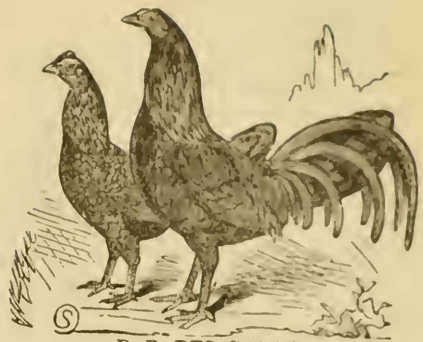
BLACK LEGHORNS.



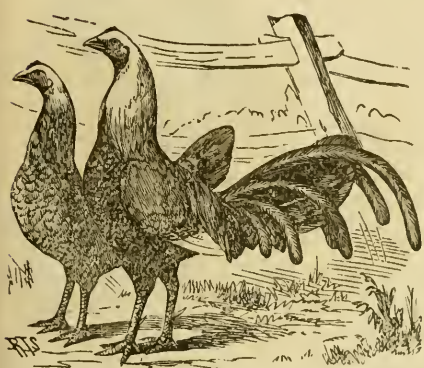
PLYMOUTH ROCKS.



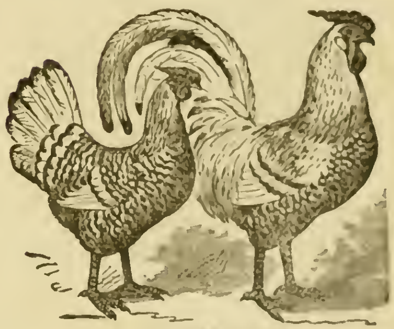
BROWN RED GAMES.



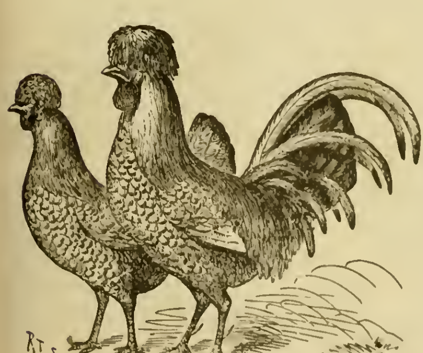
B. B. RED GAMES.



SILVER or YELLOW DUCKWING GAMES.

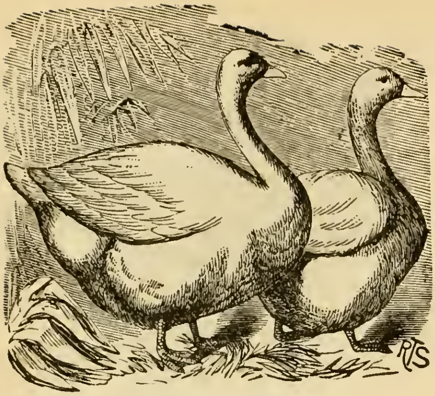


S. S. HAMBURGS.

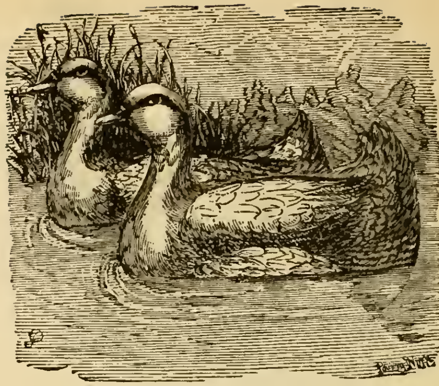


GOLDEN or SILVER S. POLISH.

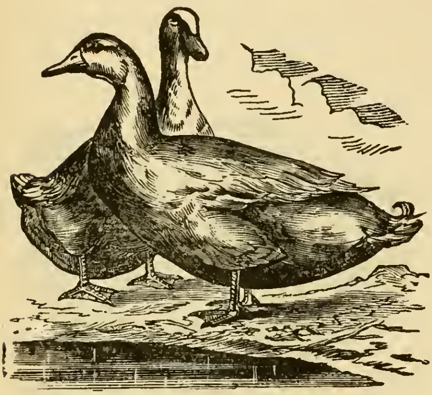
HOUDANS.



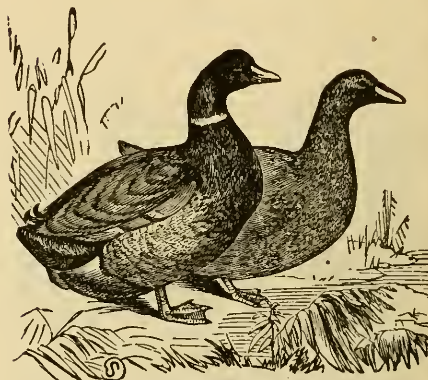
BREMEN GEESE.



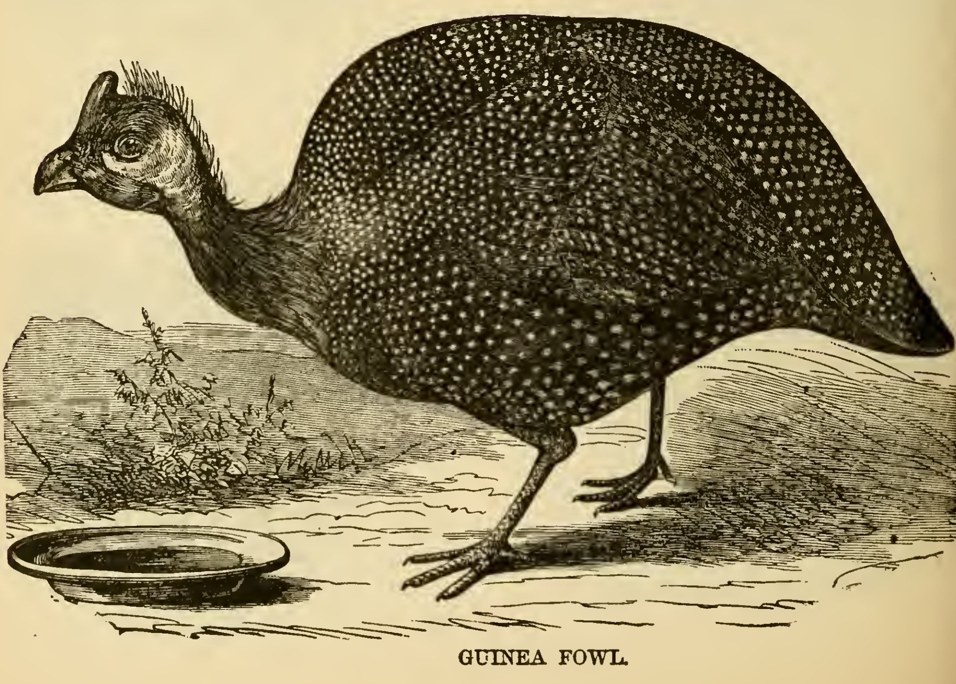
PEKIN DUCKS.



AYLESBURY DUCKS.

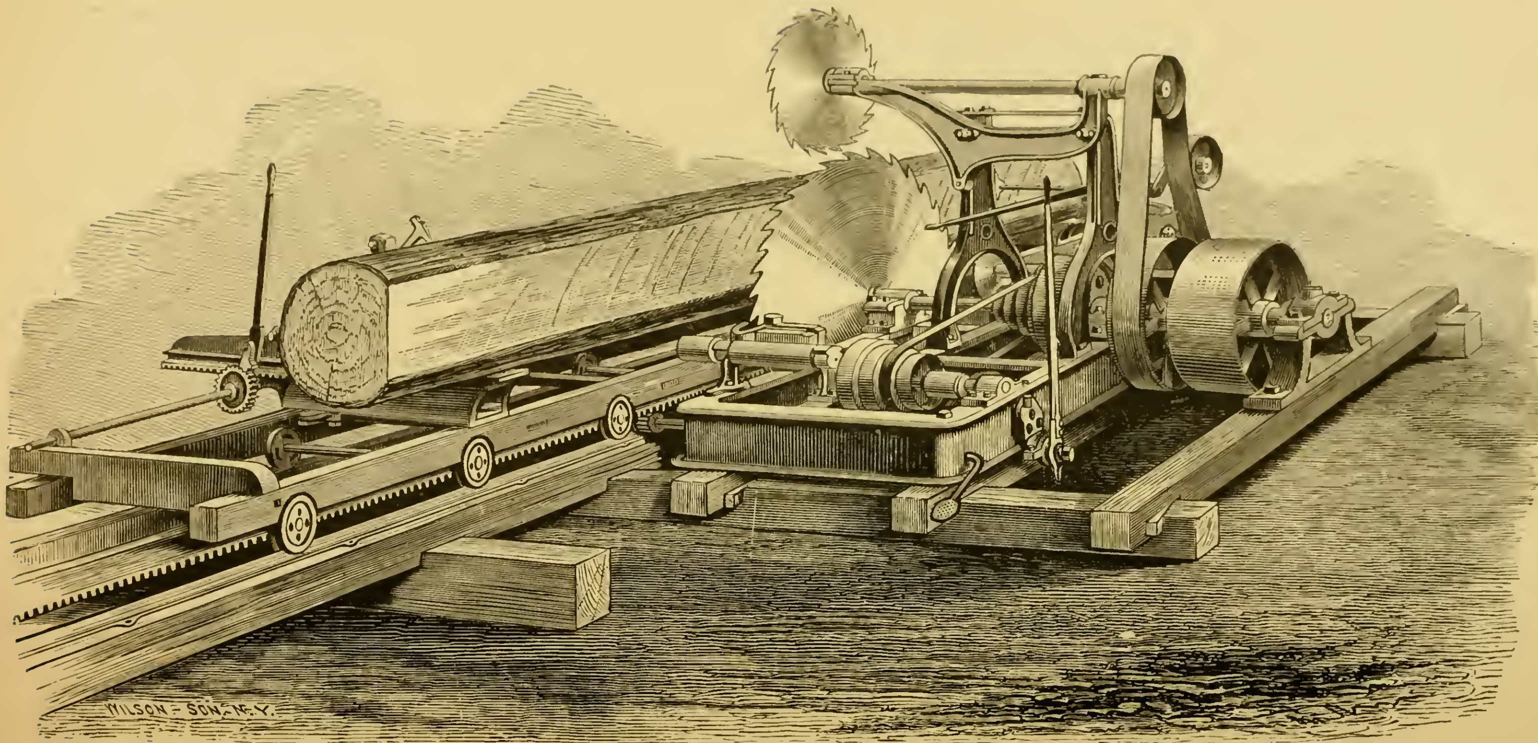


ROUEN DUCKS.

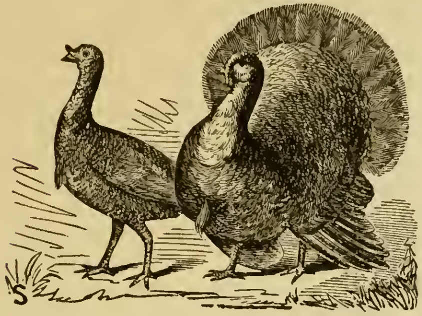


GUINEA FOWL.

SAW MILLS.




BELTED MILL, WITH TOP SAW. BUCKEYE ENGINE COMPANY, SALEM, OHIO.



BRONZE TURKEYS.

### THE LUMBER BUSINESS.

The growth and preparation of lumber does not, perhaps, come strictly within the range of what is understood by agricultural products. But the primary operations involved are to a large extent undertaken by farmers, as a part of winter's work, and lumber forms no unimportant item in the clearing up and the preparation of land for tillage. It is, therefore, proper enough to allude to it in connection with the progress of our agriculture.

Volney represented the surface of this country as one vast forest, diversified, occasionally, by cultivated intervals. Since his time the woodman's axe, guided by a ruthless hand, has reversed the picture to some extent, but still the number and variety of our forest trees abundantly testify the bounty of nature.

Originally, indeed, an almost unbroken forest covered a large proportion, not only of this country, but of the whole continent. The Indian tribes were far less populous than is generally supposed; and if we except the prairie lands of the valley of the Mississippi, but a small portion of the surface of our present territory was destitute of timber trees.

"Then all this youthful paradise around,
And all the broad and boundless mainland, lay
Cooled by the interminable wood, that frowned
O'er mount and vale, where never summer ray
Glanced till the strong tornado broke its way
Through the gray giants of the sylvan wild;
Yet many a sheltered glade, with blossoms gay,
Beneath the showering sky and sunshine mild,
Within the shaggy arms of that dark forest smiled."

It was stated by Michaux that there were in the United States one hundred and forty species of forest trees which attain a greater height than thirty feet, while in France there were only eighteen of the same description. An English traveller, writing of this country, says: "I was never tired of the forest scenery of America, although I passed through it from day to day. The endless diversity of foliage always prevents it from being monotonous." But the surpassing beauty which the forests add to our natural scenery is not to be compared with the solid advantages which are derived from the immense variety, as well as the quantity of their timber.

The forest scenery of this country beyond the Alleghany mountains, and from them to the Mississippi river, has been invaded to a less extent than in the older settled portions, and there are still vast tracts remaining uncleared. Trees of gigantic height and dimensions, standing in the richest mould, which has been accumulating for ages, and surrounded with a luxuriance of vegetation very rarely seen in the eastern states, carry the mind back to a period long anterior to the discovery of the country, and fill the beholder with awe by their grandeur.

To these forests, as they once stood. over a large portion of the country, we have been indebted for much of our growth and prosperity as a nation! How much do we not owe to one species of these majestic trees—the white pine? Michaux observed that throughout the northern states, except in the large capitals, seven-tenths of the houses are of wood, of which seven-tenths, three-quarters are of white pine. He might have said nine-tenths were built of wood, and come within the truth, though at the time he visited this country, fifty years ago, many houses had been constructed, to a great extent, of hard wood.

The new settlers had to enter and fell the forests, and burn and clear their lands as a preliminary preparation, and thousands of acres were thus brought under culture, the timber being of too little value to pay for saving. It was in vain that statutes were passed a hundred years ago and more, to prevent the cutting of trees suitable for ship timber. Private rights could not be invaded in the colonies, and down the forests came. The value of the forests for timber during the time of limited and scattered population was but little, and it could not be transported to great distances.

The lumber business, therefore, did not grow up to any great magnitude and importance till a comparatively recent period in any part of the country. Not, in fact, till the great centres of population began to feel new life from our growing commerce, creating a more extensive demand for building purposes, and for ship-building. When this period arrived, after the war of 1812 and the conclusion of peace, the lumber business began to extend itself into Maine and other regions then comparatively unsettled, especially in the vicinity of large streams giving easy access to the sea-board or to lake navigation. The mode of proceeding will be more clearly understood from the following description of the details of operations, prepared by a gentleman residing in the lumber regions of Maine. The logging camp is very much the same in all the more northern sections of the United States, from the timber regions of the St. Johns to the pineries of Wisconsin, and a detail of the winter operations of one will apply, with slight modification, to them all. I may remark, in passing, that I have myself lived some winters in the immediate vicinity of extensive logging operations in Maine, and, in fact, been engaged in them to some extent, and am familiar with them.

When a lumberer has concluded to log on a particular tract, the first step is to go with a part of his hands and select suitable situations for building his camps. In making this selection, his object is to be near as possible to the best clumps of timber he intends to haul, and to the streams into which he intends to haul it. He then proceeds to build his camps and to cut out and clear out his principal roads The camps are built of logs, being a kind of log-houses. They are made about three feet high on one side, and eight or nine on the other, with a roof slanting one way. The roof is made of shingles split out of green wood and laid upon rafters. The door is made of such boards as can be manufactured out of a log with an axe. Against the tallest side of the camp is built the chimney—the back being formed by the wall of the camp, and the sides made of green logs, piled up for jams, about eight feet apart. The chimney seldom rises above the roof of the camp; though some who are nice in their architectural notions sometimes carry it up two or three feet higher. It is obvious from the construction that nothing but the greenness of the timber prevents the camp from being burned up immediately; yet the great fires that are kept up make but little impression in the course of the winter upon the back or sides of the chimney. A case, however, happened within a year or two, where a camp took fire in the night and was consumed, and the lumberers in it burned to death. Probably the shingle roof had become dry, in which case a spark would kindle it, and the flames would spread over it in a moment. Parallel to the lower side of the building, and about six feet from it, a stick of timber runs on the ground across the camp. The space between this and the lower wall is appropriated to the bedding, the stick of timber serving to confine it in its place. The bedding consists of a layer of hemlock boughs spread upon the ground, and covered with such old quilts and blankets as the tenants can bring away from their homes. The men camp down together, with their heads to the wall and their feet toward the fire. Before going to bed they replenish their fire—some two or more of them being employed in putting on such logs as with their handspikes they can manage to pile into the chimney. As the walls of the building are not very tight, the cool air plays freely around the head of the sleeper, making a difference of temperature between the head and the feet not altogether agreeable to one unused to sleep in camps. A rough bench and table complete the furniture of the establishment. A camp very similar, though not so large in dimensions, is built near for the oxen; on the top of this the hay is piled up, giving warmth while it is convenient for feeding.

A large logging concern will require a number of camps, which will be distributed over the tracts, so as best to accommodate the timber. One camp serves generally for one or two teams. A team, in ordinary logging parlance, expresses, not only the set of four or six oxen that draw the logs, but likewise a gang of men employed to tend them. It takes from three or four to seven or eight men to keep one team employed—one man being employed in driving the cattle, and the others in cutting down the trees, shaping them into logs, barking them, and cutting and clearing the way to each tree. The number of hands required is inversely

Fig. 1.
HAULING LOGS.

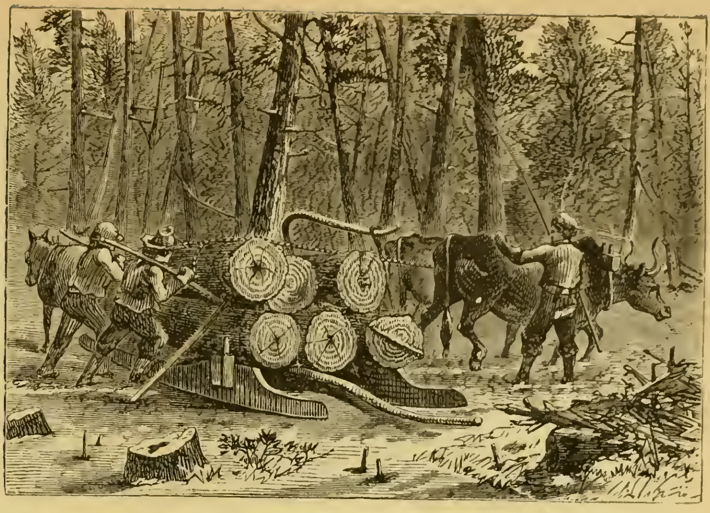


Fig. 2.
SAWING OFF LOGS.

Fig. 3.
FLOATING LOGS.

Fig. 4.
THE JAM.

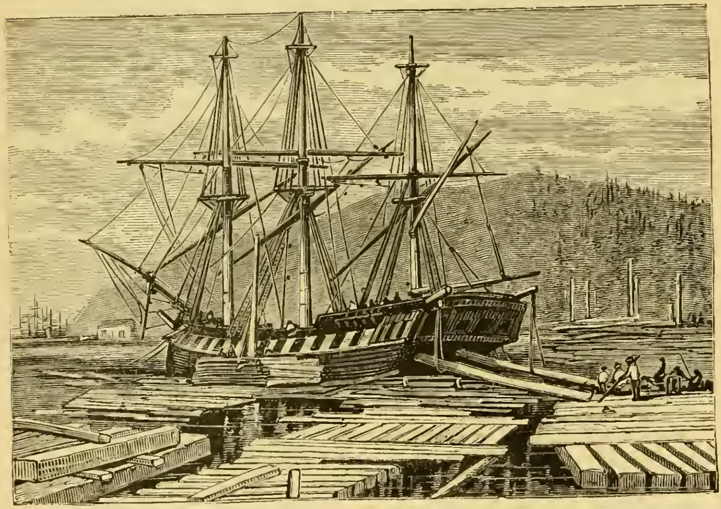


Fig. 5.
LOADING THE SHIP.

Fig. 6.
LUMBERMAN'S CABIN.

to the distance the logs are to be hauled; that is, most hands are required when the distance is shortest, because the oxen, returning more frequently, require their loads to be prepared more expeditiously. Having built their camps, or while building them, the main roads are to be cut out. These run from the camps to the landing places, or some stream of sufficient size to float down the logs on the spring freshet. Other roads are cut to other clumps of timber. They are made by cutting and clearing away the underbrush, and such trees and old logs as may be in the way, to a sufficient width for the team of oxen, with the bob-sled and timber on it, to pass conveniently. The bob-sled is made to carry one end of the timber only, the other drags upon the ground, and the bark is chipped off, that the log may slip along more easily. The teams proceed to the woods, when the first snows come, with the hands who are not already there, and the supplies. The supplies consist principally of pork and flour for the men, and Indian meal for the oxen; some beans, tea, and molasses are added. Formerly hogsheads of rum were considered indispensable, and I have before me a bill of supplies for a logging concern of three teams in 1827–28, in which I find one hundred and eighty gallons of rum charged; but of late very few respectable lumberers take any spirits with them, and the logging business is consequently carried on with much more method, economy, and profit. The pork and flour must be of the first quality. Lumberers are seldom content to take any of an inferior sort; and even now, when flour is twelve dollars a barrel, they are not to be satisfied with the coarser breadstuffs. Hay is procured as near to the camps as possible; but as most of the timber lands are remote from settlements, it is generally necessary to haul it a considerable distance; and as it must be purchased of the nearest settlers, they are enabled to obtain very high prices. From twelve to twenty dollars per ton is usually paid. When the expense of hauling it to the camp is added, the whole cost is frequently as high as thirty dollars a ton, and sometimes much higher. Owners of timber lands at a distance from settlements may make a great saving by clearing up a piece of their land, and raising their own hay. Some one of the hands, who has not so much efficiency in getting timber as skill in kneading bread and frying pork, is appointed to the office of cook. Salt pork and flour bread constitute the regular routine of the meals, varied sometimes with salt fish or salt beef. Potatoes are used when they can be obtained. Now and then, perhaps, when the snow is deep, they catch a deer, and live on venison. The men are employed through the day in cutting the timber and driving the teams. In the evening some take care of the oxen; some cut wood for the fire; then they amuse themselves with stories and singing, or in other ways, until they feel inclined to turn in upon the universal bed. On Sundays the employer claims no control over their time, beyond the taking care of the cattle, the fire, and the cooking. On this day they do their washing and mending; some employ themselves, besides, in seeking timber, and some in hunting partridges, while some remain in the camp and read the Bible. They remain in the woods from the commencement of sledding, some time in December, until some time in March, in the course of which month their labors are usually brought to a close by the snow, it becoming too shallow or too deep. If there are heavy thaws the snow runs off, not leaving enough to make good hauling. If, on the other hand, it gets to be four or five feet deep, the oxen cannot break through it to make the path which it is necessary to form in order to get at each individual tree. The men and teams then leave the woods. Sometimes one or two remain to be at hand when the streams open. I know one who last winter staid by himself in the woods, fifteen or twenty miles from the nearest habitation, for the space of twenty-eight days, during which time he earned $203 by getting in timber with his axe alone, being allowed for it at the same rate per thousand that the lumberers were in getting it in with their teams. He found some berths in the banks of the stream, where all that was necessary was to fell the tree so that it should fall directly upon the water, and there cut it into logs to be ready for running. When the streams are opened, and there is sufficient freshet to float the timber, another gang, called "river drivers," takes charge of it. It is their business to start it from the banks, and follow it down the river, clearing off what lodges against rocks, pursuing and bringing back the sticks that run wild among the bushes and trees that cover the low lands adjoining the river, and breaking up jams that form in narrow or shallow places.

A *jam* is caused by obstacles in the river catching some of the sticks, which in their turn catch others coming down; and so the mass increases until a solid dam is formed, which entirely stops up the river, and prevents the further passage of any logs. These jams are most frequently formed at the top of some fall; and it is often a service that requires much skill and boldness, and is attended with much danger, to break them up. The persons who undertake it must go on the mass of logs, work some out with their pick poles, cut some to pieces, attach ropes to others to be hauled out by the hands on shore, and they must be on the alert to watch the moment of the starting of the timber, and exercise all their activity to get clear of it before they are carried off in its tumultuous rush. Some weeks, more or less, according to the distance, spent in this way, bring the timber to the neighborhood of the saw-mills. A short distance from Oldtown, on the Penobscot, there is a boom established, extending across the river, for the purpose of stopping all the logs that come down. It is made by a floating chain of logs, connected by iron links, and supported at suitable distances by solid piers, built in the river; without this it would be impossible to stop a large part of the logs, and they would be carried on the freshet down the river, and out to sea. The boom is owned by an individual, who derives a large profit from the boomage, which is thirty-five cents per thousand on all logs coming into it. The boom cost the present owner about $40,000. He has offered it for sale for $45,000. It is said the net income from it some years is $15,000. Here all the logs that come down the Penobscot are collected in one immense mass, covering many acres, where is intermingled the property of all the owners of timber lands in all the broad region that is watered by the Penobscot and its branches, from the east line of Canada, above Moosehead Lake, on the one side, to the west line of New Brunswick on the other. Here the timber remains till the logs can be sorted out for each owner, rafted together, and floated to the mills or other places below.

*Rafting* is the connecting the logs together by cordage, which is secured by pins driven into each log, forming them into bands, like the ranks of a regiment. This operation is performed by the owner of the boom. The ownership of the timber is ascertained by the marks which have been chopped into each log before it left the woods, each owner having a mark, or combination of marks, of his own. When the boom is full, only the logs lowest down can be got at; and the proprietors of other logs must wait weeks, sometimes months, before they can get them out, to their great inconvenience and damage. After the logs are rafted and out of the boom, a great part of them are lodged for convenience in a place called Pen Cove, which is a large and secure basin in the river, about two miles below the boom. From this cove they can be taken out as they are wanted for the mills below. While in the boom and at other places on the river, they are liable to great loss from plunderers. The owners or drivers of logs will frequently smuggle all that come in their way, without regard to marks. The owners or conductors of some of the mills on the river are said to be not above encouraging and practising this species of piracy. Indeed, timber in all its stages seems to be a fair object for plunderers, from the petty pilferer who steals into the woods, fells a tree, cuts it into shingles, and carries it out on his back, to the comparatively rich owner of thousands of dollars.

When the logs have been sawn at the mills, there is another rafting of the boards, which are floated down the river to Bangor, to be embarked on board the coasters for Boston. In this process they are subject to much injury: first, by the mode of catching them as they come from the mill sluices, the rafters making use of a picaroon, or pole, with a spike in the end of it, which is repeatedly and unmercifully driven into the boards, taking out, perhaps, a piece at each time; secondly, by the holes made by the pins driven into the boards in rafting; and, thirdly, by the rocks, and rapids, and shallows in the river, breaking the rafts to pieces and splitting up the boards as they descend. These inconveniences will be partly remedied by the railroad now in operation, unless other inconveniences in the use of it should be found to overbalance them. The kinds of timber brought down our rivers are pine, spruce, hemlock, ash, birch, maple, cedar, and hackmatack. Far the greater part of it is pine. The lumberers make about six kinds of pine, though they do not agree exactly in the classification, or in the use of some of the names. The most common division is into pumpkin-pine, timber-

# PRODUCTS OF THE PINE FORESTS *

Turpentine, rosin, tar, and pitch, are largely used in various trades, as well as for many domestic purposes. One of our artists has sent us a series of sketches from the pine regions, and a friend, familiar with the processes of manufacturing the products, has furnished us an account of them. The Long-leaved Pine grows from the north-eastern boundary of North Carolina, along the Atlantic coast to Florida, across that State to the Gulf, and thence to Louisiana, in a belt averaging 100 miles in width. The manufacture was first commenced in North Carolina, and that State still supplies by far the largest proportion of the product. The first step is to obtain the Crude Turpentine. This is the natural juice of the pine tree, and is sometimes called White Turpentine, and Gum Turpentine. It is a mixture of the volatile oil known as Spirits of Turpentine, and of Rosin. A half-moon-shaped box is cut in the tree, as near as possible to the surface of the ground. The shape of this "box" will be seen in figs. 2, 3, and 4. The box cutting commences about the 1st of December, and continues until March—perhaps a few weeks longer, if the spring is late. A hand can cut from 100 to 150 boxes per day, from one quart to half a gallon in capacity. After cutting, the boxes are "cornered" by taking out a triangular piece at each end of the half-moon. This is the commencement of the regular season, and the boxes are now all tasked off. A "task" is usually 10,000 boxes, but I have known hands to tend 18,000. These must be cornered once, and "hacked" about six times, from the first of spring until into November. The dipping (shown in fig. 3) is done by task-work, too, so many barrels or boxes per day being a task. Two dippers generally attend one hacker. Hacking is the making a groove-shaped cut on each side, downward, to the centre of the half-moon. These grooves can be seen in all the cuts. The barrels for filling are placed at intervals through the woods; the dipper gathers his gum in a rude bucket, and empties it into the barrels, which, when full, are hauled off. A frequent mode of hauling is seen in fig. 1; the same cut shows a primitive but cheap mode of "rolling" tar to market. Both articles are frequently rafted to a seaport between sticks of hewn timber.

The first year's operation produces "virgin dip," the second "yellow dip," the third some common yellow dip and scrape; then the further product of the trees is

*Copied from the American Agriculturist.

all "scrape." The virgin dip is, when carefully gathered, a honey-like gum, of whitish appearance. From it are produced No. 1, pale, extra, and window glass rosins. It yields about 7 gallons of spirits and not quite three-fourths of a barrel of rosin to the barrel (280 lbs.) Yellow dip yields over three-fourths of rosin, and about 6 gallons of spirits to the 280 lbs. of gum. Scrape yields about the same. "Scrape" is the gum which gathers on the face of the tree or box when worked up three, four, or more feet. It is a white, cheesy-like substance. The operation of chipping the box-face and gathering the scrape is seen in figs. 3 and 4. With care a very light rosin can be made from it.

The operation of distilling the gum is carried on in copper stills of a capacity from ten barrels up to sixty. They are bricked up at the sides, and the fire strikes directly on the bottom. The top has a large hole for the "cap," which connects with the worm for condensing the spirits, and a small hole through which the "stiller" examines the state of his charge, and lets in water as it may be needed. The rosin, being a residuum, is let off on one side into vats, from which it is dipped into barrels to cool. The rear of the stills and the rosin vats are shown in fig. 5. A task of 10,000 boxes may safely be calculated to yield two hundred and fifty barrels of virgin or yellow dip in a season. In trees deadened by fire, stumps of trees cut down when the sap is up, and old boxed trees left standing, a peculiar transformation of the wood takes place; all its pores become filled with pitchy matter, it increases greatly in weight, and will take fire almost as readily as gunpowder. This wood is the source of tar. The wood is split into billets 3 or 4 feet long, and about 3 inches in diameter. To form a tar kiln the wood is piled concentrically, each layer projecting over the lower a little until a desired height is reached, this encircled with logs, and covered with clogs, as shown in fig. 6. A kiln yields fifty, one hundred, or more barrels of tar, according to its size. Pitch is tar boiled down until all its volatile matter is driven off. The manufacture of tar is chiefly carried on by the poor whites and negroes.

Large quantities of valuable timber are produced from the pine forests, known at the North as Southern pine lumber.

The engravings accompanying this article are from sketches drawn from life by our special artist, Mr. C. C. Burr, of Wilmington, N. C.

pine, sapling, bull-sapling, Norway, and yellow, or pitch-pine. The pumpkin-pine stands pre-eminent in the estimation of the lumberers, because it is the largest tree, and makes fine, large, clear boards. They are soft, and of a yellowish cast. The timber-pine and saplings are the most common. The former is generally preferred, as being larger and more likely to be sound; yet the saplings are said to make the harder and more durable boards. The common sapling grows in low lands, generally very thick, but much of it is apt to be rotten. The bull-sapling is larger and sounder, grows on high land, and is mixed with hard wood. The Norway pine is a much harder kind of timber than the others. It is seldom sawn into boards, though it makes excellent floor-boards; but it is generally hewn into square timber.

I will conclude with some remarks upon the different modes of operating made use of by owners of timber. There are three. One is for the owner to hire his men by the month, procure teams, and furnish them with equipments and supplies. A second is to agree with some one or more individuals to cut and haul the timber, or cut, haul, and run it, at a certain price per thousand feet. The third way is to sell the *stumpage* out right: that is, to sell the timber standing. The first mode is seldom adopted, unless the owner of the timber is likewise a lumberer, and intends to superintend the business himself. The second mode is very common. It is considered the most saving to the owners, because the lumberer has no inducement to select the best timber, and leave all that is not of the first quality; to cut down trees and take, and leave others to rot that are not quite so good, but may be worth hauling. Its inconveniences are, that, as the object of the lumberer is to get as large a quantity as possible, he will take trees that are not worth so much as the cost of getting them to market, and which, besides being of little value themselves, render the whole lot less saleable by the bad appearance they give it. The owner, too, is subject to all the losses that may happen in running the logs down the river. Very frequently he is obliged to make a contract to have the timber cut and hauled to the landing-places, and another to have it run down; for the river-drivers are a distinct class from the lumberers. Most of them, indeed, are lumberers; yet it is but a small part of the lumberers that are river-drivers. A great part of the lumberers are farmers, who must be on their farms at the season of driving, and, therefore, cannot undertake any thing but the cutting and hauling. They are paid for the number of thousand feet they deposit at the landing-places; and the logs being surveyed, or scaled, as they are hauled, their object is to get as many thousand feet as possible on the landing-places; while the river-drivers may be very careless about getting them all down, and the owner may never receive the whole quantity he has paid for cutting and hauling. In operating in this mode, the owner usually furnishes the supplies, provisions, etc., and the lumberer procures the teams and hires the men. The owner, commonly, does not bind himself to pay before the logs go to market, and he frequently makes a contract for his supplies on the same condition, in which case he has to pay from twenty-five to thirty-three per cent. more for his goods than he would dealing on cash or common credit. Sometimes, when there is no freshet, the logs do not go down until the second year; and then the trader and lumberer both suffer for want of their pay.

The third mode is by far the simplest and easiest for the owner. He avoids all trouble of furnishing supplies, of watching the timber on the river, and of looking out for a market. But he must have a man of some capital to deal with, as he furnishes his own teams and supplies, and pays the men, receiving very heavy advances. The purchaser of it has no interest to cut the timber savingly, and he sometimes makes dreadful havoc among the trees, leaving a great deal of valuable stuff on the ground to rot. And if he selects only the best trees in a berth, much of the timber left standing may be lost, because no one will afterward want to go into that berth from which all the best trees have been culled. It is common now to employ a man to pass the winter in the camps, living alternately at one or another, for the purpose of scaling the logs, keeping a correct account of them, and seeing that the timber is cut according to the contract.

But, after all, there is almost always found to be a considerable difference between timber cut by the thousand and that which is cut on stumpage. Each mode has its troubles; but I think that owners at a distance will manage their concerns with least vexation by selling the stumpage, provided that they have honest men to deal with.

It might be mentioned in connection with the above interesting statement, that the primary object in the settlement of Maine was to engage in the lumber business. Agriculture was originally secondary to that business, and grew up of necessity, in connection with it. The same may be said of some parts of New Hampshire. Mason and Gorges procured their grant, embracing a large tract above Portsmouth, Dover, etc., for the purposes of lumbering and the manufacture of potash. It was common in Maine for a lumberman to work at farming in summer, and cut and haul lumber in the winter.

A brief description of lumbering at Green Bay, in the northern part of Wisconsin, will be interesting in this connection.

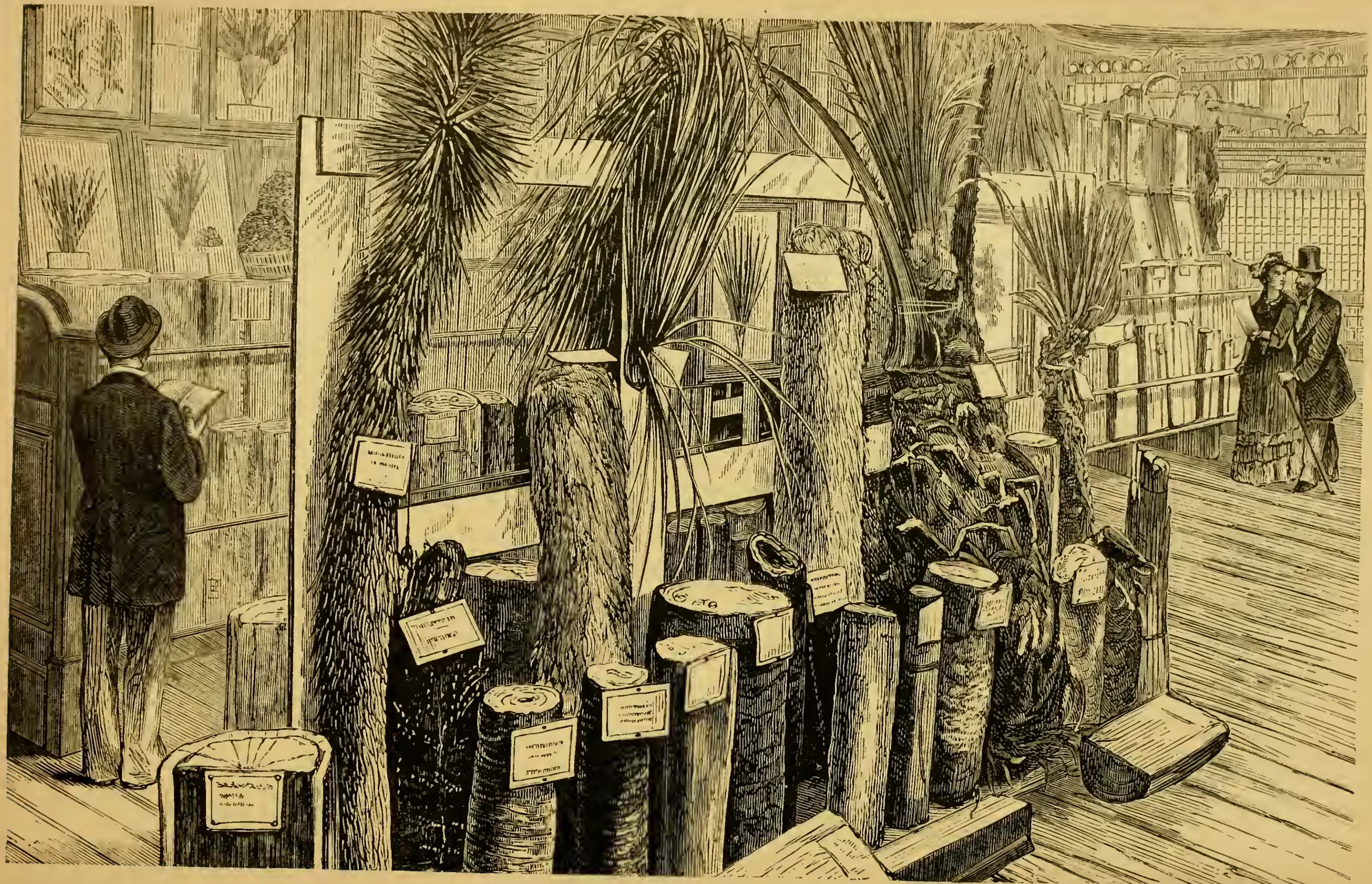
"A logging camp in the winter," says a resident of Green Bay, "is an exhilarating scene. The great trees falling here and there, with a thundering sound; the fine, strong teams moving off to the river with their loads, and hurrying back with empty sleds; the songs and shouts of the jolly, red-shirted lumbermen; the majestic forest scenery, standing out so handsomely in the clear air of northern winter, make up a panorama that is worth going a day's journey to see. Finally, the snow fades out before the spring sun. It goes first from the logging road, because there it has been most worn; and then the lumbermen make ready for the 'running,' and wait impatiently for the breaking up of the stream and the coming of the freshet. If they are a long way up the stream, this is a matter of great anxiety, for, perhaps, the rise will not be sufficient, and their logs will lie over till another year. One firm on the Oconto got logs as high up as ninety miles from the mouth. If the water is high, the logs come down by thousands upon thousands, rushing, clogging up, breaking away again, piling upon each other, and requiring the constant efforts of the drivers to keep them on the go. Sometimes, when an obstruction occurs, a few logs form a 'jam,' and those coming after them, with terrific force, are piled up in rude masses, till one not familiar with it would think the whole enterprise hopelessly ended, for there seems no possibility of ever extricating the mass, perhaps, of a thousand logs. But a single man, with an iron-shod handspike, goes upon the jam carefully, looking with a practised eye here and there, until he discovers one log which is the key to the whole problem. Prying cautiously, he loosens it, and then makes his way as quick as possible to the shore again. The confused mass begins to settle, the head logs start; and then, all at once, down stream they go once more, with the old speed, like a herd of countless buffaloes stamping along the prairie. The logs reach the mill in April or May, and the sawing commences on the arrival of the 'head of the drive.'"

In the absence of accurate statistics, which ought to have been furnished by the last census, it is not possible to give a detailed statement of the full extent of the lumber business of the country; and hence, any information on the subject must necessarily come far short of giving an adequate idea of its vastness, and of the progress which the last few years have witnessed in its development. But we know that the export of lumber from the United States has risen from $1,822,077 in 1821 to $16,237,376 in 1880; we know that during the five years from 1873 to 1877 the value of the lumber exported was nearly ninety-four millions of dollars; we know that the amount of lumber received at Chicago alone in one year (1872) was no less than 1,183,659,283 feet, besides one hundred and thirty-nine millions of laths. Chicago, indeed, as a lumber market, stands pre-eminent, and its rise and progress as such is little less remarkable than its growth as a grain market. The banks of the rivers are loaded for several miles with vast piles of lumber, shipped to that city from the extensive pine forests of Michigan, Wisconsin, and Canada; while the capital invested in this trade is immense. The vessels alone which are engaged in carrying the lumber which finds its market there, did not cost less than four millions and a half; and the number of hands employed in one way and another is not less than 60,000.

Here are some of the receipts of lumber in that city:—

| | Lumber—Feet. | Shingles. | Laths. |
|---|---|---|---|
| 1847 | 32,118,225 | 12,148,500 | 5,665,700 |
| 1852 | 147,816,232 | 77,080,500 | 19,759,670 |
| 1857 | 444,396,300 | 130,463,000 | 79,650,000 |
| 1861 | 249,308,000 | 79,336,000 | 32,667,000 |
| 1865 | 658,214,476 | 197,159,000 | 64,255,000 |
| 1868 | 999,229,866 | 560,877,000 | 145.337,600 |
| 1872* | 1,183,659,283 | 610,824,420 | 139,000,000 |
| 1874 | 1,060,088,000 | 619,279,000 | |
| 1875 | 1,147,193,000 | 635,708,000 | |
| 1878 | 1,092,530,000 | 605,941,000 | |

*One year after the great fire.



SUB-TROPICAL TREES OF THE UNITED STATES.

This, it must be borne in mind, is the business of only one city. Many other cities and larger towns might be named which would compare favorably with it.

In what has been said above, reference has been had exclusively to the procuring of lumber for the purposes of building. The vast amount required for fuel has not been considered, but if that could be taken into account it would form an item of amazing importance, not only as ministering to the comfort of millions of people, but in a commercial and business point of view.

But while Chicago stands pre-eminent as a lumber market, other cities have very large interests in the business. The lumber production of the state of Michigan in 1875 was 2,691,965,388 feet of lumber and 1,383,870,000 shingles—more than double the Chicago receipts. The amount of lumber which was received at tide-water (Albany, Troy, Waterford, and New York), in 1878, was 586,907,939 feet. The production of the Pacific slope is enormous, and none of it comes east of the Rocky Mountains. The value of the lumber and timber produced annually exceeds 250 million dollars.

There is also an immense consumption of timber and lumber in the mining districts in timbering the mines, the erection of flumes, smelters, reduction works, etc. What seem to be manufactures of trifling importance consume large quantities. Two million cords of pine are used in the manufacture of matches, and 300,000 in the production of spools for cotton and silk. Even in districts where there were extensive forests not long since, wood has become so costly that coal takes its place for fuel, and notwithstanding extensive tree planting, the disappearance of our forests is inevitable.

### PROGRESS OF AGRICULTURAL LITERATURE.

The improvement and increase of the agricultural literature of the country might very properly have been treated of in the early part of this chapter, as among the means or the causes of the progress which has been made in the development of our agricultural wealth, to which it has contributed nearly as much, perhaps, as the agricultural societies themselves. I have, however, preferred to reserve it for this position, for the reason that it may with equal propriety be said to have grown out of a demand for information incident to the general spirit of inquiry which the association of effort produced in the public mind, and especially since it has, for the most part, grown up within the last twenty years, or long subsequent to the formation of many of the agricultural societies.

If we except the "Essays on Field Husbandry," by the Rev. Jared Eliot, of Connecticut, prepared as early as the middle of the last century, and the valuable papers submitted to the Massachusetts, the New York, and the Pennsylvania Agricultural Societies, and published by them about the beginning of the present century, we cannot be said to have had any agricultural literature, till within the memory of many men still living. None, in fact, till within the last twenty or thirty years. The "Essays on Field Husbandry," considering the time when they were written, were certainly a remarkable contribution to the agricultural literature of the country, filled with the most judicious advice, and worthy of republication, both as a part of the history of our agriculture and for their own intrinsic merits. But, as already remarked on a former page, the book was far in advance of the farming community of that time, and it is not probable that it had many readers. The papers published by the Massachusetts Society for Promoting Agriculture, commenced as early as 1796, were among the most valuable that have ever appeared in this country. They are embraced in a series of ten octavo volumes, called the "Agricultural Repository," and extend over a period of thirty years, discussing many questions which agricultural chemistry and other kindred sciences have since definitively settled and explained, but containing much useful information on a great variety of subjects connected with practical agriculture. The agricultural library connected with my office is one of the most valuable and extensive in the country, but I regard the "Agricultural Repository" as among the most valuable series in it.

The farming community gradually "took to reading." The *American Farmer* was commenced in Baltimore, Maryland, in 1819, and is believed to have been the first strictly agricultural periodical started in the country. It was sold in 1829 for twenty thousand dollars, which, at that time, was a very large price for an agricultural paper. It has been regularly published up to this time, and is still in a flourishing condition, with a good circulation.

The *Agricultural Intelligencer* was established in Boston in 1820, but for some reason or other, probably for want of sufficient support, was discontinued, and the *New England Farmer* was begun in 1822 by Thomas G. Fessenden. This journal, an eight page quarto, was continued with a varying fortune till 1846, when it died, but another of the same name, an octavo monthly and folio weekly, sprang up, and is still in the full tide of success. The *New York Farmer* was established soon after the *New England Farmer*, and was continued for several years by Mr. Samuel Fleet, then sold to Mr. D. K. Miner, who engaged the services of Mr. Henry Colman as editor, till the journal died, and is no more. In 1831, Mr. Luther Tucker, one of the oldest agricultural editors of the country, established the *Genesee Farmer*, at Rochester, N. Y. At the end of the first year it had but six hundred subscribers. But Mr. Tucker persevered, until, in 1839, the subscription reached 19,000.

In the meantime, Judge Buel had established the *Cultivator*, at Albany, in 1833, and at his death, in 1839, Mr. Tucker purchased that journal of his heirs, and removed to Albany, uniting the *Genesee Farmer* and the *Cultivator* which is still in a very flourishing condition, having exerted a long-continued and wide-spread influence. The place made vacant by the removal of the *Genesee Farmer* from Rochester was soon filled by the *New Genesee Farmer*, soon after which the first word of the title was dropped, and as the *Genesee Farmer*, was published till 1867 when it was united with the *Agriculturist*. The *American Agriculturist*, established about the year 1842, was continued with some success for some years, till its subscription list became reduced to a few hundreds, when it passed into new hands, felt the infusion of younger blood, and in less than fifteen years the subscription has risen to 180,000. The *Farmers' Cabinet* was published some years in New York city, under the editorship of J. S. Skinner, who first established the *American Farmer*, at Baltimore. Mr. Skinner, in 1848, started the *Plough, Loom, and Anvil*, which was continued till about 1858. The *Maine Farmer* was established about the year 1832, and has exerted a good influence.

Many other agricultural papers have been started within twenty-five or thirty years past, and have received a generous patronage from the farming community, among which ought to be mentioned the *Rural New Yorker*, with a very wide circulation; the *Country Gentleman*, published in connection with the *Cultivator*, at Albany; the *Ohio Farmer*, of very wide influence and large circulation; the *Michigan Farmer*, at Detroit; the *Valley Farmer*, at St. Louis; the *Wisconsin Farmer*, at Madison; the *North-Western Farmer*, at Dubuque; the *Southern Planter*, at Richmond; the *California Farmer*, at Sacramento; the *Homestead*, at Hartford, Connecticut—all exceedingly valuable and well conducted papers; the *Working Farmer*, in New York city, and many others with which I am less familiar. There are in the northern and western states more than ninety journals, weekly, semi-monthly, and monthly, devoted almost exclusively to agriculture, and horticulture, and the aggregate circulation of these is not less than 800,000 copies. There are, also, in the southern states, about twenty similar publications devoted to agriculture, whose aggregate circulation is not less than eighty-five thousand copies. These facts are exceedingly important with reference to the present condition of our agriculture, since they indicate a wide-spread spirit of inquiry and intelligence among farmers, which must necessarily have an important influence on the future development of this great interest.

Besides the large number and wide circulation of the journals devoted to agriculture, there is a good demand for agricultural books, and many of the standard works published in Europe have been republished in this country, including Stephens' "Book of the Farm," Thaer's "Principles of Agriculture," Johnston's "Agricultural Chemistry," and many other European works of established reputation. These foreign works were soon followed by American treatises on landscape gardening, fruits, animals, draining, dairy farming, and, in fact, on subjects covering the whole ground of farm economy, more or less perfectly. Many of these treatises and republications have had a wide circulation. The "Modern Horse Doctor" has sold to the extent of more than fifty thousand copies, "Youatt and Martin on Cattle," over twenty thousand, "Youatt on the Horse" over sixty thousand, and many others in a similar proportion.

The Thomas Farmer's Almanac, from which the above engravings were taken, was about the only agricultural literature the farmers had in the early days of the Republic. The cuts also represent the style of engravings of those days. The Almanac informed the readers in what changes of the moon to plant various vegetables, such as squashes, cucumbers, beans, etc. The illustrations also showed people in which month certain work should be done, such as plowing, threshing, making cider, mending fences, etc., the time to take comfort by sitting around the fire rolling the hoop, and the like. It may surprise young people to learn that said Almanac issued weather probabilities for the whole year in advance. Along down the column of figures giving the day of the month would be inserted, "About this time look out for rain," "High winds and rain," "We may expect snow-storms about this time," etc. Of course it was a very fine thing to know what the weather would be all the year round, but the trouble was the probabilities often proved to be very improbable.

In addition to these facilities for information, many of the states have established township and district libraries, by means of which the choicest works on all subjects are brought within the reach of all, the poor as well as the rich. In these libraries are generally included a fair proportion of agricultural works.

This system was initiated by New York in 1837, by making an appropriation of two hundred thousand dollars a year for three years, and subsequent annual grants of over fifty thousand dollars. Massachusetts followed the example of New York in 1839, and more recently Michigan passed a law giving each township the sum of fifty dollars annually for this purpose. Indiana adopted the same policy in 1854, and Ohio in 1857, the former appropriating $300,000 for two years, and the latter $80,000 annually. Illinois and other western states have also adopted a similar course.

These measures are properly regarded as well calculated to diffuse information, and promote not only agricultural improvement, but the general welfare of the community. To this should be added the fact that most states publish annually an abstract of the proceedings of the county agricultural societies for general gratuitous distribution. Many of the states produce volumes of great value. Ohio distributes from twenty to thirty thousand copies. Massachusetts publishes ten thousand copies, and Maine as many more. These various instrumentalities are now in constant activity, and are exerting an immense influence.

Allusion should also be made to the establishment, in some of the states, of agricultural colleges, where special attention is to be given to the various sciences which bear directly or indirectly upon practical agriculture. Michigan was the first to lead off in this direction; a liberal endowment was granted by the state. New York, Maryland, and other states soon followed; but the results of these institutions are not yet attained, nor can they at present be fully appreciated, since time only can prove their value and their efficiency.

This brief survey of the growth of the facilities for information upon agricultural subjects and the appliances brought to bear upon the instruction of the young farmer, will sufficiently indicate the rapidity of the progress which has been made in this particular direction within the last ten or twenty years, and justify the hope and expectation of the most splendid results in the future.

It ought not to be overlooked, in this connection, that there has been a most decided progress within the last twenty years in agricultural chemistry and kindred sciences. This progress has been made not wholly and strictly by scientific men in our own country, but scientific discoveries in agriculture are the property of the intelligent farmer everywhere, and those made abroad have had a material and important influence in promoting the advancement of practical agriculture among us.

The labors of Arthur Young and Sir Humphry Davy were exceedingly valuable, but they bear the same relation to more recent investigations that the labors of the pioneer in the western forest do to those of the sons who till the soil and reap the harvests for which the father had prepared the way. The former did more than any other man to stir up the agricultural mind of his country. The latter was the first to give principles to practice, and he announced the new philosophy in these words: "Vegetables derive their component principles—which are, for the most part, hydrogen, carbon, oxygen, and nitrogen—either from the atmosphere by which they are surrounded, or from the soil in which they grow. The process of vegetation appears to depend upon the perpetual assimilation of various substances to the organs of the plant, in consequence of the exertion of their living and of their chemical affinities."

The conversion of inorganic bodies into gases, and the assimilation of gases by organic structures, formed the basis for a new starting point, and had never before been announced. Carbonic acid had been discovered by Black in 1752. Dr. Rutherford called attention to nitrogen in 1772, and Priestley discovered oxygen in 1774, and obtained it from the leaves of plants; and when Davy appeared with a series of investigations more intimately connected with agriculture, the properties of air and water had not long been known. But little progress had been made in vegetable anatomy. Most of all that is known with regard to the organs of plants—their mode of growth by food taken from the air, from water, from manure, and from the soil by transmuting processes of wonderful delicacy—has been discovered within the last fifty years. Since

Davy's time, the processes of chemical analysis have been vastly improved, and abstract chemistry itself has grown up to a science of inestimable importance, which it had not in his day. The accumulation of scientific facts is the work of time, and it was not till 1840 that Liebig prepared his report on the progress of agriculture for the British Association for the Advancement of Science, and opened a new world of thought and study, awakened the attention of practical farmers to the importance of applying the results of chemical investigations, and, in some respects, essentially modified the practice of all civilized countries.

Liebig said, in his "Organic Chemistry," that "to manure an acre of land with forty pounds of bone dust, is sufficient to supply three crops of wheat, clover, potatoes, turnips, etc., with phosphates, but the form in which they are restored to the soil does not appear to be a matter of indifference. For the more finely the bones are reduced to powder, and the more intimately they are mixed with the soil, the more easily they are assimilated. The most easy and practical mode of effecting their division is to pour over the bones, in the state of fine powder, half of their weight of sulphuric acid, diluted with three or four parts of water." The leading idea in this and other propositions of Liebig opened the way for the whole system of artificial manuring, which has extended so far in modern times. Previous to that time, the farmer had confined himself to the use either of a compost of animal and vegetable materials, or of other simple substitutes, as ashes, salt, soot, or something of the kind; but not in accordance with any fixed principles derived from reasoning or the results of observation, but simply because experience had shown them to be beneficial. Liebig's idea was that sulphuric acid, the vitriol of commerce, would make the neutral phosphate of lime soluble, and give it a powerful action in the soil. For the subsequent discovery and use of mineral phosphates we are indebted to the same source, the development and application of the views first advanced by Liebig.

Immediately after the announcement of his propositions, experiments were instituted with such satisfactory results that manufactories were established in England, and the importation of bones from Germany, the United States, and South America, became of great importance to commerce as well as to agriculture; while the earnest researches of scientific men soon discovered the most approved formulas for the manufacture of superphosphate of lime, and other concentrated artificial manures. The best methods of preparing these substances were thus made known both by scientific and practical men.

The advantage of these discoveries cannot be disputed, for though the farmer may be liable to be deceived in the purchase of a particular kind of superphosphate, yet there is no longer any doubt of its great value as a fertilizer, when properly made; while its introduction rendered substances previously of little worth, easily and quickly available for the nourishment of plants, and hence very valuable.

It was these investigations that made known the value of guano as a fertilizer. This substance has come into use since the year 1840, when twenty casks were landed in England, where it was soon found to be a most valuable manure. So great was the confidence immediately inspired in its value as a means of increasing the products and renovating the soil of the country, that the very next year, 1841, seven vessels were employed to convey 1,733 tons from the Chincha Islands to England, and the number increased in 1842 to forty-one British and three foreign vessels, and the amount imported to 13,094 tons. Before the close of 1844, no less than 29,000 tons were imported into that country from the coast of Peru, to say nothing of the many thousand tons which came from the Ichaboe and other guano islands at that time discovered. In 1855, no less than 210,000 tons were sold in England, being an increase of twenty per cent. on the consumption of 1854, which was at least twenty per cent. over that of 1853. From 1841, the date of the extraction of guano, to any extent, from the Chincha Islands, to the end of 1856, the quantity removed from those islands alone reached the enormous figure of two millions of tons, and the aggregate amount of sales in that time was $100,263,519. From the commencement of 1851 to June 30, 1880, there were imported into the United States for use as manures about 1,175,000 tons of Peruvian guano. The supply of this article is now nearly exhausted. In 1878, the surveying engineers estimated that only about 2,400,000 tons remained, and that the annual consumption in all countries was 345,000 tons—less than a seven years' supply. The war between Chili and Peru has since interfered with the export of guano. The consumption of Peruvian guano has decreased materially since 1872, that from the border islands near our own coast, and owned by our own people having very largely taken its place. Of this guano about 42,000 tons were brought into market in the 4 years, 1876–80. Nitrate of Soda (Cubic Niter) has been largely imported from Peru, Bolivia, and Chili, into European and American markets since 1866—for manures and for the production of commercial nitric acid. The entire export from these countries has averaged about 275,000 tons annually, of which the United States have averaged about 27,000 tons. The supply of this will hereafter be controlled by Chili. What proportion is used for manures, it is difficult to say. "Fish guano," or the residuum or scrap left after the expression of oil from the menhaden at the oil factories on the coast, is also largely used. The manures produced from the rendering companies, and the night soil companies, the superphosphates, ground and crushed bones, &c., &c., are also largely used.

In 1867 immense deposits of coprolites (the dung of fossil animals,) as well as fossil bones were discovered near Charleston, S. C., as well as on St. Helena Island, somewhat later, and these have now become important articles of commerce, under the name of rock phosphates. But there is gradually returning, a decided preference for stable and barnyard manures, if properly composted, and this preference will be greatly increased by the general introduction of the system of ensilage, followed as it must be by a great increase in the amount of live stock, and especially of milch cows, oxen, and fat cattle. It seems impossible to increase the supply of pure milk, butter, and cheese as rapidly as the great cities demand these articles, either for their own consumption or for export. By this system, as we have shown elsewhere, an acre of land will furnish the support for 8 months of ten cows—and the production of manure, if properly husbanded, will be enormous, restoring to our lands more than we have taken from them. It would be well if the farmers who cultivate the wheat and corn lands of the west would adopt this plan and give back to the soil what they take from it, but for the most part in the newer states and territories, they use no manures and rotation of crops is almost unknown.

### THE PROSPECTS OF AGRICULTURE IN THIS COUNTRY.

Having given some of the features of agricultural progress in the preceding pages, it is proper to say, in conclusion, that the present is but the dawn of a new era—an era of improvements of which we cannot yet form an adequate conception. The scientific discoveries, the mechanical inventions, the general spirit of inquiry, and the wide-spread intelligence which have been alluded to, indicate that a greater application of the mind to the labors of the hand distinguishes the present generation over all preceding times in a manner which those only can appreciate who will look back and consider the past—the slow growth of new ideas and new practices, the struggles with prejudice, ignorance, the want of markets, and the want of means, all of which contributed to depress American agriculture fifty years ago, and to keep it at a point wretchedly low, compared even with what it is at the present time. We have seen not only the calling, but the men who live by it gradually rising in dignity, in self-respect, and the respect of mankind. It is an imperative law of society that educated mind and educated labor will take its position above uneducated; in proportion as the farmer of to-day is better educated and more intelligent than the farmer of half a century ago, the former would naturally stand above the latter in the general estimation of the community. But in many other respects the farmer of the present day is far in advance of his forefathers. His labor is easier, and his mental activity is consequently greater. The same amount of manual labor produces more, and the farmer has time for the culture of the mind and the social virtues, as well as the farm, and agriculture holds a position of pre-eminence unknown at any former period.

These changes we have seen in our own day, and we know that a higher development of our agricultural wealth must go hand in hand with an increase of population, if there were no other stimulus to its growth. Now, if we consider the immense area of the United States, and the facilities for the expansion of our population, the mind itself is incapable of fixing limits to the increase of this grand interest, already involving a greater amount of the wealth of the country than any other, producing annually to the value of more than twenty-five hundred millions of dollars, and capable of a hundred-fold greater development than that which it has already attained.

The original area of the country was only 815,615 square miles, but by successive purchases, treaties and conquests it has been more than quadrupled. The additions thus made were: the purchase of Louisiana in 1803, comprising, with the subsequent treaties with Spain, and our discoveries and explorations, the region west of the Mississippi extending to the mouth of the Sabine on the Gulf, and taking in the sources of all the affluents of the Mississippi on the west, to the highest crest or great divide of the Rocky Mountains, and north of the 42d parallel, extending to the Pacific on the west, and the line of British America on the north; the final settlement of title to the Mississippi territory east of that river, from 1804 to 1812; the purchase of Florida and the Gulf coast to the Mississippi from Spain in 1819; the annexation of Texas in 1845; the Mexican session of the treaty of Guadaloupe Hidalgo, in Feb. 1848, and the Gadsden purchase in 1853; the settlement of the N. E. and N. W. boundary by treaties and arbitrations with Great Britain, from 1846 to 1880; and the purchase of Alaska from Russia in 1867. By these cessions, annexations, purchases and treaties, our area has been enlarged to its present dimensions, 3,580,242 square miles. The growth of population over this area since 1790 has been as follows, the population of cities and its ratio to the entire population, together with the number of persons to the square mile of the area of settlement:

| Year. | Total Area of Settlement.* | Population. | No. of Inhab'ts to Sqr. Mile. | Population of Cities. | Ratio to whole Population. | Ext of Contin's Settlm't. N. Lat. | W. Long. |
|---|---|---|---|---|---|---|---|
| 1790 | 239.93 | 3,929,214 | 16 4 | 131,472 | 3.4 | 31°–45° | 67°–83° |
| 1810 | 407.945 | 7,239,881 | 17.7 | 356,920 | 4.9 | 9°30′–45°15′ | 67°–88°30′ |
| 1830 | 632,717 | 12,866,020 | 20.3 | 864.50 | 6.7 | 29°15′–46°15′ | 67°–95° |
| 1850 | 979 249 | 23,891,876 | 23.7 | 2,897.586 | 12.5 | 28°30′–46°30′ | 67°–99° |
| 1870 | 1,272,239 | 38,558,371 | 30 2 | 8 071,875 | 20.9 | 27°15′–47°30′ | 67°–99°45′ |
| 1880 | 2,584.371 | 50,152,866 | 19.4 | 12,403,183 | 24.93 | 29°–47°30′ | 67°–123° |

*The area of settlement includes only those regions where the population exceeds two to the square mile. Those regions below this density contain in all less than one-half of one per cent. of the population. As the rural population, i. e., those not inhabiting cities—is still a little more than 75 per cent of the whole, it follows that agriculture is yet the predominant pursuit in the nation—and the annual productions of the field, the forest and the herds and flocks show that our national wealth is very largely derived from these sources.

| | |
|---|---|
| The products of 11 of the principal crops in 1880 was . . | $2,184,412,232 |
| The value of the live stock that year was estimated at . | 1,594,407,556 |
| The orchard and vineyard prouucts were about . . . . | 456,000,000 |
| The dairy products, . . . . . . . . . . . . . . . | 576,700,000 |
| The forest products, . . . . . . . . . . . . . | 478 000,000 |
| Making a grand total of, . . . . . . . . . . . . | $5,289,519,788 |

This is exclusive of the value of farms, farm improvements and machinery, and slaughtered animals, as well as of all minor crops. We are yet only on the threshold of our agricultural advancement. With scores of millions of rich and fertile lands awaiting the plough; with agricultural machinery which reduces farm labor to a minimum, and enables the farmer to cultivate a thousand acres with greater ease than he could have cultivated fifty thirty years ago; with a variety of climate which permits the cultivation of every kind of crop, whether of grains or fruits; and sufficient rainfall or opportunity of irrigation to insure a certainty of perfecting the crops; with railways traversing nearly every county in most of the states, and the best agricultural sections, even in the territories, and bringing all that they can raise to good markets at prices which are not extravagant; with an enterprise and competition which awakes the ambition of even the most sluggish, and a demand for all that they can produce, the farmers of the United States have a magnificent future before them. Monopoly, and the concentration of a vast capital upon any pursuit, so as to command the market and crush out the small manufacturer or dealer, is the rule now in almost every kind of business, but the small farmer who is out of debt and willing to work can be independent of the monopolists, can sell his crops for cash, and make his profits, without asking the leave of the Dalrymples or Grandins, and indeed may be benefited rather than injured by their vast expenditure.

There is no unalloyed prosperity in this world, and he may find that in some years floods, or extraordinary falls of snow, Rocky Mountain locusts or Colorado beetles, intense drought or constant and drenching rains may cut short his crops, or that overproduction may glut for a while the European markets; but if he understands his business and attends to it industriously, not putting all his land into one crop and contending manfully against misfortunes, he will find that taking the years together, he is amassing a competency more surely than he can do in almost any other avocation.

Three things have contributed greatly to this rapid progress in agriculture during the past ten or fifteen years: 1. Associated action on the part of the farmers. The

Grange movement has very possibly been perverted in some cases into a political engine, but its effect in many of the western and central states, in producing united action among the farmers and lifting them out of the slough of debt, was good. They are using much more and better agricultural machinery also, than they would have done had not the Grangers given their influence in favor of them. The organization of Farmers' Clubs, Agricultural societies, &c., has also been beneficial.

2. The greatly increased diffusion of agricultural knowledge by books, periodicals and the reports of the Agricultural Department. The development of the sorghum as a sugar-producing plant, is very largely due to the energetic efforts of the head of that department.

3. The immigration of great numbers of the most intelligent European farmers into our western states has given a wonderful impulse to farming. The Mennonites, and large bodies of German and Scandinavian agriculturists have been of great advantage to the West, and, indeed, to the whole country.

There are several measures of great importance yet to be adopted for the advance of agriculture in the near future. One of these is the general adoption of the ensilage system, and the rearing of a greater number of cows, stock cattle, and sheep. Another is deeper ploughing, more thorough cultivation, and a great increase in the use of manures, which ensilage will render possible. The elements taken from the soil must be returned to it; and while guano, the superphosphates and nitrates are very good in their way, there is nothing better than properly composted stable manure. In the rearing of cattle, sheep, and swine, and in all the dairy processes there should be greater attention paid to perfect cleanliness and the avoidance of all food which will impair the health of the animals. Pleuro-pneumonia, hog cholera, sheep rot, and chicken cholera, destroy annually domestic animals enough to feed almost our entire population—and they can be prevented by proper care and watchfulness.

What is sent to market, should be the very best the farmer can raise or produce; and he should try to make his products better and better ever year. This is the only way to make farming pay.

There should be more effort to diversify crops. Where the cereals have been cultivated exclusively, change to root crops, sorghum, flax, hemp, or ramie. Let him devote a few acres to peanuts, castor beans, strawberries, raspberries, or blackberries. He will do well to start an orchard and take good care of it. If the situation is favorable let him commence a vineyard, planting the best grapes, and when they are in bearing, market his surplus; it will pay better than wine-making. Let him keep bees; they are profitable; or rear silkworms if the climate is right. The women and children can feed and care for them, and ere long there will be a demand for American reeled silk. By thus diversifying his industry the farmer runs less risk and can make his farm very profitable.

# DATES OF ADMISSION OF STATES—POPULATION AND VALUATION.

| Old Thirteen States. | Date of admission. | Area, Sq. miles. | 1790. Population. | 1790. Valuation. | 1850. Population. | 1850. Assessed Valuation.† | 1860. Population. | 1860. True Valuation. | 1870. Population. | 1870. True Valuation. | 1880. Population. | 1880. True Valuation.‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Delaware, | 1787 | 2,050 | 59,096 | $4,053,238 | 91,532 | $15,896,870 | 112,216 | $46,242,181 | 125,015 | $97,180,833 | 146,608 | 103,759,295 |
| Pennsylvania, | 1787 | 45,215 | 434,373 | 72,824,252 | 2,311,786 | 500,275,851 | 2,906,215 | 1,416,501,818 | 3,521,951 | 3,808,310,112 | 4,282,890 | 4,568,299,108 |
| New Jersey, | 1787 | 7,815 | 181,139 | 27,287,981 | 489,555 | 153,251,619 | 672,035 | 467,918,324 | 906,096 | 940,976,064 | 1,131,116 | 1,091,813,997 |
| Georgia, | 1788 | 59,475 | 82,548 | 10,263,506 | 906,185 | 121,619,729 | 1,057,286 | 645,895,237 | 1,184,109 | 268,169,207 | 1,542,180 | 312,067,293 |
| Connecticut, | 1788 | 4,990 | 237,946 | 40,163,955 | 370,792 | 119,088,672 | 460,147 | 444,274,114 | 537,454 | 774,631,524 | 622,700 | 805,234,181 |
| Massachusetts, | 1788 | 8,315 | 378,787 | 59,441,642 | 994,514 | 551,106,824 | 1,231,066 | 815,2[illegible]7,433 | 1,457,351 | 2,132,148,741 | 1,783,085 | 2,817,291,666 |
| Maryland, | 1788 | 12,210 | 319,728 | 21,634,004 | 583,034 | 139,026,601 | 687,049 | 376,919,944 | 780,894 | 643,748,976 | 934,943 | 1,092,681,547 |
| South Carolina, | 1788 | 30,570 | 249,073 | 12,450,720 | 668,507 | 105,737,492 | 703,708 | 548,138,754 | 705,606 | 208,146,989 | 995,577 | 261,827,419 |
| Rhode Island, | 1788 | 1,250 | 68,825 | 8,082,355 | 147,545 | 77,758,974 | 174,620 | 135,337,588 | 217,353 | 296,965,646 | 276,531 | 329,614,903 |
| New Hampshire, | 1788 | 9,305 | 141,885 | 19,028,108 | 317,976 | 92,251,596 | 326,073 | 156,310,860 | 318,300 | 252,624,112 | 346,981 | 3[illegible]6,182,069 |
| Virginia, | 1788 | 42,450 | 747,610 | 59,976,860 | 1,421,661 | 252,105,824 | 1,596,318 | 793,249,681 | 1,225,163 | 409,588,133 | 1,512,565 | 454,186,954 |
| New York, | 1788 | 49,170 | 340,120 | 74,885,075 | 3,097,394 | 715,369,038 | 3,880,735 | 1,843,338,517 | 4,382,759 | 6,500,841,264 | 5,082,871 | 8,279,100,716 |
| North Carolina, | 1789 | 52,250 | 393,751 | 27,909,479 | 869,039 | 71,702,740 | 992,622 | 358,739,399 | 1,071,361 | 260,757,244 | 1,399,750 | 313,251,429 |
| Total old States, | | 325,065 | 3,639,003 | $438,001,175 | 12,269,520 | $2,915,185,830 | 14,800,090 | $8,048,103,850 | 16,433,252 | $16,594,118,845 | 20,057,797 | $20,735,310,517 |
| District of Columbia, | 1790 | 70 | .... | ... | 51,687 | $14,409,413 | 75,080 | $41,084,945 | 131,700 | $126,873,618 | 177,624 | $168,108,763 |
| Vermont, | 1791 | 9,565 | 85,425 | $15,165,484 | 314,120 | 72,980,484 | 315,098 | 122,477,170 | 330,551 | 235,349,553 | 332,286 | 229,735,207 |
| Kentucky, | 1791 | 40,400 | 73,677 | 20,268,325 | 982,405 | 177,013,407 | 1,155,684 | 666,043,112 | 1,321,011 | 604,318,552 | 1,648,690 | 683,719,2[illegible]7 |
| Tennessee, | 1796 | 42,050 | 35,691 | 5,847,662 | 1,002,717 | 107,981,793 | 1,109,801 | 493,903,892 | 1,258,520 | 498,237,724 | 1,542,359 | 513,211,791 |
| Ohio | 1802 | 41,060 | .... | .... | 1,980,329 | 433,872,632 | 2,339,511 | 1,193,898,422 | 2,665,260 | 2,235,430,300 | 3,198,062 | 3,327,6[illegible]8,247 |
| Louisiana, | 1812 | 48,720 | ... | .... | 517,762 | 176,623,654 | 708,002 | 602,118,568 | 726,915 | 323,125,666 | 939,946 | 322,128,726 |
| Indiana, | 1816 | 36,350 | .... | .... | 988,416 | 152,870,399 | 1,350,428 | 528,835,371 | 1,680,637 | 1,268,180,543 | 1,978,301 | 1,654,217,825 |
| Mississippi, | 1817 | 46,810 | .... | .... | 606,526 | 85,901,204 | 791,305 | 607,324,911 | 827,922 | 209,197,345 | 1,131,597 | 219,006,493 |
| Illinois, | 1818 | 56,650 | .... | .... | 851,470 | 114,782,645 | 1,711,951 | 871,860,282 | 2,539,891 | 2,121,680,579 | 3,077,871 | 3,144,108,319 |
| Alabama, | 1819 | 52,250 | .... | .... | 771,623 | 98,870,118 | 964,201 | 495,237,078 | 996,992 | 201,855,841 | 1,262,505 | 207,651,378 |
| Maine, | 1820 | 33,040 | 96,540 | .... | 583,169 | 96,790,513 | 628,279 | 190,211,600 | 626,915 | 348,155,671 | 648,936 | 361,274,183 |
| Missouri, | 1821 | 69,415 | .... | .... | 682,044 | 86,802,101 | 1,182,012 | 501,214,398 | 1,721,295 | 1,284,922,897 | 2,168,380 | 1,402,779,018 |
| Arkansas, | 1836 | 53,850 | .... | .... | 209,897 | 20,372,101 | 435,450 | 219,256,473 | 484,471 | 156,394,691 | 802,525 | 173,152,873 |
| Michigan, | 1837 | 58,915 | .... | .... | 397,654 | 30,877,223 | 749,113 | 257,163,983 | 1,184,059 | 719,208,118 | 1,636,937 | 1,386,583,454 |
| Florida, | 1845 | 58,680 | .... | .... | 87,445 | 10,921,107 | 140,424 | 73,101,500 | 187,748 | 44,163,655 | 269,493 | 51,643,117 |
| Texas, | 1845 | 265,780 | .... | .... | 212,592 | 30,149,671 | 604,215 | 365,200,614 | 818,579 | 159,052,542 | 1,591,749 | 627,196,820 |
| Iowa, | 18[illegible]5 | 56,025 | .... | .... | 192,214 | 23,714,638 | 674,913 | 247,338,265 | 1,194,020 | 717,644,750 | 1,624,615 | 1,027,173,289 |
| Wisconsin, | 1847 | 56,040 | .... | .... | 305,391 | 26,715,525 | 775,881 | 273,671,668 | 1,054,670 | 702,307,329 | 1,315,497 | 878,637,801 |
| California, | 1850 | 158,360 | .... | .... | 92,597 | 21,923,173 | 379,994 | 207,874,613 | 560,247 | 638,767,017 | 864,694 | 1,278,963,125 |
| Minnesota, | 1857 | 83,365 | .... | .... | 6,077 | 262,088 | 172,023 | 52,294,413 | 439,706 | 228,909,590 | 780,773 | 709,616,297 |
| Oregon, | 1859 | 96,030 | .... | .... | 13,294 | 5,063,474 | 52,465 | 28,930,639 | 90,923 | 51,558,932 | 174,768 | 106,128,334 |
| Kansas, | 1861 | 82,080 | .... | .... | .... | .... | 107,206 | 31,327,895 | 364,399 | 188,892,014 | 995,096 | 339,263,122 |
| West Virginia,* | 1862 | 24,780 | .... | .... | .... | .... | . | ... | 442,014 | 190,651,491 | 618,457 | 199,272,183 |
| Nevada, | 1864 | 110,700 | .... | .... | .... | .... | 6,857 | .... | 42,491 | 31,134,012 | 62,266 | 58,605,129 |
| Nebraska, | 1867 | 76,855 | .... | .... | .... | .... | 28,841 | 9,131,056 | 122,993 | 69,277,483 | 452,402 | 217,168,800 |
| Colorado, | 1876 | 103,925 | .... | .... | .... | .... | 34,277 | .... | 39,864 | 20,243,303 | 194,327 | 156,[illegible]21,785 |
| TERRITORIES: | | | | | | | | | | | | |
| Indian Territory, | | 64,690 | ... | .... | 7,500 | .... | 75,441 | .... | ... | .... | ab. 70,000 | .... |
| New Mexico, | 1850 | 122,580 | .... | .... | 61,547 | 5,174,471 | 93,516 | 20,813,768 | 91,874 | 31,319,793 | 119,565 | 37,114,591 |
| Utah, | 1850 | 84,970 | .... | .... | 11,380 | 986,083 | 40,273 | 5,596,118 | 86,786 | 16,159,995 | 143,963 | 53,380,908 |
| Washington, | 1853 | 69,180 | .... | .... | .... | .... | 11,594 | 5,601,466 | 23,955 | 13,562,164 | 75,116 | 56,220,749 |
| Dakota, | 1861 | 149,100 | .... | .... | .... | .... | 4,837 | .... | 14,181 | 5,599,752 | 135,177 | 55,263,285 |
| Arizona, | 1863 | 113,020 | .... | .... | .... | .... | .... | .... | 9,658 | 3,410,791 | 40,440 | 21,678,126 |
| Idaho, | 1863 | 84,800 | .... | .... | .... | .... | .... | .... | 14,999 | 6,552,681 | 32,610 | 12,197,205 |
| Montana, | 1864 | 146,080 | .... | .... | .... | .... | .... | .... | 20,595 | 15,184,522 | 39,159 | 49,293,714 |
| Wyoming, | 1868 | 97,890 | .... | .... | .... | .... | .... | .... | 9,118 | 7,016,748 | 20,789 | 27,841,216 |
| Alaska, | 1870 | 577,390 | ... | .... | .... | .... | .... | ... | .... | | ab. 50,000 | .... |
| Total new States and Ter., | | 3,277,925 | 291,333 | $41,281,471 | 10,929,856 | $1,795,060,916 | 16,643,231 | $8,111,512,220 | 22,125,719 | $13,474,399,682 | 30,216,975 | $19,765,844,961 |
| Grand Total, | | 3,602,990 | 3,929,214 | 479,282,646 | 23,067,262 | †4,710,246,746 | 31,443,321 | 16,159,616,068 | 38,558,371 | 30,068,508,507 | 50,155,783 | 40,501,155,477 |

* Included in Virginia till 1862. † The "true" valuation for 1850 was $7,135,780,128.

‡ It is to be noted that both the assessed and true valuations were taken in 1870 in currency values, which were not less than 30 per cent. above gold values, and in a time of great prosperity, and that both valuations in 1880 were taken at gold values, and at a time of financial depression, which had lasted seven years, and under which values had shrunk at least one-third; that fourteen of the states reported a much lower assessed valuation in 1880 than in 1870, and that six more had barely held their position; and that the principal increase in the true valuation was in the enhanced value of property not taxed.

## CENSUS OF 1860, 1870, AND 1880.

**Population of the United States.—General Nativity and Foreign Parentage.**

[From the Reports of the Superintendent of the Census.]

| States and Territories. | 1860. | | | 1870. | | | 1880. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total population. | Native born. | Foreign born. | Total population. | Native born. | Foreign born | Total population. | Native born. | Foreign born. |
| Total United States,.. | 31,443,321 | 27,304,624 | 4,138,697 | 38,558,371 | 32,991,142 | 5,567,229 | 50,152,866 | 43,475,506 | 6,677,360 |
| Total States,......... | 31,183,744 | 27,084,592 | 4,099,152 | 38,115,641 | 32,642,612 | 5,473,029 | 49,368,595 | 42,874,232 | 6,495,363 |
| Alabama, ............ | 964,201 | 951,849 | 12,352 | 996,992 | 987,030 | 9,992 | 1,262,794 | 1,253,121 | 9,673 |
| Arkansas,............ | 435,450 | 431,850 | 3,600 | 484,471 | 479,445 | 5,026 | 802,564 | 792,269 | 10,295 |
| California,........... | 379,994 | 233,466 | 146,528 | 560,247 | 350,416 | 209,831 | 864,686 | 572,006 | 292,680 |
| Colorado, ............ | ......... | ......... | ......... | 39,864 | 33,265 | 6,599 | 194,649 | 154,869 | 39,780 |
| Connecticut,......... | 460,147 | 379,451 | 80,696 | 537,454 | 423,315 | 113,639 | 622,683 | 492,879 | 129,804 |
| Delaware, ........... | 112,216 | 103,051 | 9,165 | 125,015 | 115,879 | 9,136 | 146,654 | 137,182 | 9,472 |
| Florida,............. | 140,424 | 137,115 | 3,309 | 187,748 | 182,781 | 4,967 | 267,351 | 257,631 | 9,720 |
| Georgia,.... ........ | 1,057,286 | 1,045,615 | 11,671 | 1,184,109 | 1,172,982 | 11,127 | 1,539,048 | 1,528,735 | 10,315 |
| Illinois, ............. | 1,711,951 | 1,387,308 | 324,643 | 2,539 891 | 2,024,693 | 515,198 | 3,078,769 | 2,495,177 | 583,592 |
| Indiana,............. | 1,350,428 | 1,232,144 | 118,284 | 1,680,637 | 1,539,163 | 141,474 | 1,978,362 | 1,834,597 | 143,765 |
| Iowa,................ | 674,913 | 568,836 | 106,077 | 1,194,020 | 989,328 | 204,692 | 1,624,620 | 3,363,132 | 261,488 |
| Kansas,.............. | 107,206 | 94,515 | 12,691 | 364,399 | 316,007 | 48,392 | 995,966 | 886,361 | 109,705 |
| Kentucky, ........... | 1.155,684 | 1,095,885 | 59,799 | 1,321.011 | 1,257,613 | 63,398 | 1,648,708 | 1,589,237 | 59,471 |
| Louisiana,........... | 708,002 | 627,027 | 80.975 | 726.915 | 655,088 | 61,827 | 940,103 | 885,964 | 54,139 |
| Maine. .............. | 628,279 | 590,826 | 37,453 | 626,915 | 578,034 | 48,881 | 648,945 | 590,076 | 58,869 |
| Maryland,............ | 687,049 | 609,520 | 77,529 | 780,894 | 697,482 | 83,412 | 934,632 | 851,984 | 82,648 |
| Massachusetts, ....... | 1,231,066 | 970,960 | 260,106 | 1,457,351 | 1,104,032 | 353.319 | 1,783,012 | 1,339,916 | 443,093 |
| Michigan,......... ... | 749,113 | 600,020 | 149,093 | 1,184,059 | 916,049 | 268,010 | 1,636,331 | 1,247,985 | 388,346 |
| Minnesota, .......... | 172,023 | 113,295 | 58,728 | 439,706 | 279,009 | 160,697 | 780,806 | 513,107 | 267,699 |
| Mississippi,.......... | 791,305 | 782,747 | 8,558 | 827,922 | 816,731 | 11,191 | 1,131,592 | 1,122,424 | 9,168 |
| Missouri, ............ | 1,182,012 | 1,021,471 | 160,541 | 1,721,295 | 1,499,028 | 222,267 | 2,168,804 | 1,657,564 | 211.240 |
| Nebraska,............ | 28,841 | 22,490 | 6,351 | 122,993 | 92,245 | 30 748 | 452.433 | 355,043 | 97,390 |
| Nevada, ...... ....... | 6,857 | 4,793 | 2,064 | 42,491 | 23,690 | 18.801 | 62,265 | 36,623 | 25,642 |
| New Hampshire,..... | 326,073 | 305,135 | 20,938 | 318,300 | 288,689 | 29,611 | 346.984 | 300,961 | 46,023 |
| New Jersey, ......... | 672,035 | 549,245 | 122,790 | 906,096 | 717,153 | 188.943 | 1,130,983 | 909,398 | 221,585 |
| New York, .......... | 3,880,735 | 2,879,455 | 1,001,28 | 4,382,759 | 3,244,406 | 1,138,353 | 5,083,810 | 3.872,372 | 1,211,438 |
| North Carolina,...... | 992,622 | 988.324 | 3,298 | 1.071,361 | 1,068,332 | 3,029 | 1,400,047 | 1,399,368 | 3,679 |
| Ohio, ................ | 2,339,511 | 2,011,262 | 328,249 | 2,665,260 | 2,392,767 | 375,493 | 3,198,239 | 2,803,496 | 394,743 |
| Oregon,.............. | 52,465 | 47.342 | 5,123 | 90,923 | 79,323 | 11,600 | 174,767 | 144,327 | 30,440 |
| Pennsylvania,........ | 2,906,215 | 2,475,710 | 430,505 | 3,521,951 | 2,976,642 | 545,309 | 4,282,786 | 3,695,253 | 587.333 |
| Rhode Island,........ | 174,620 | 137.226 | 37,394 | 217,353 | 161,957 | 55,396 | 276.528 | 202,598 | 73,930 |
| South Carolina, ...... | 703,708 | 693,722 | 9,980 | 705,606 | 697,532 | 8,074 | 995,622 | 987,981 | 7,641 |
| Tennessee, .......... | 1,109,801 | 1,088,575 | 21,226 | 1,258,520 | 1,239,204 | 19,316 | 1,542.463 | 1,525,881 | 16.582 |
| Texas,............... | 604,215 | 560.743 | 43,422 | 818,579 | 756,168 | 62,411 | 1,592,574 | 1,498,139 | 114.516 |
| Vermont, ............ | 315,098 | 282,355 | 32,743 | 330,551 | 283,396 | 47,155 | 332,286 | 291.340 | 40,946 |
| Virginia.......... ... | 1,219,630 | 1,201.117 | 18.513 | 1,225,163 | 1,211,409 | 13,754 | 1,512,806 | 1.448,139 | 14,667 |
| West Virginia,....... | 376,688 | 360.143 | 16.545 | 442,014 | 424,923 | 17,091 | 618,443 | 600,214 | 18,229 |
| Wisconsin,... ....... | 775.881 | 498,954 | 276,927 | 1,054,670 | 690,171 | 364,499 | 1,315,480 | 910,063 | 405,417 |
| Total Territories,.... | 259,757 | 220,032 | 39,545 | 442,730 | 348,530 | 94,200 | 783,271 | 601,284 | 181.997 |
| Arizona,..... . ...... | ......... | ......... | ......... | 9,658 | 3,849 | 5,809 | 40,441 | 24.419 | 16.022 |
| Dakota, .............. | 4.837 | 3,063 | 1,774 | 14,181 | 9,366 | 4,815 | 135,180 | 83.387 | 51,793 |
| District of Columbia,. | 75,080 | 62,596 | 12,481 | 131,700 | 115,446 | 16.254 | 177.638 | 160,523 | 17.115 |
| Idaho, ............ .. | ......... | ......... | ......... | 14,999 | 7,114 | 7,885 | 32.611 | 22,629 | 9 982 |
| Montana,............. | ......... | ......... | ......... | 20,595 | 12,616 | 7,979 | 39,157 | 27.642 | 11.515 |
| New Mexico,......... | 93,516 | 86,793 | 6,723 | 91.874 | 86,254 | 5.620 | 118,430 | 108,498 | 9,932 |
| Utah, ............... | 40,273 | 27,519 | 12,754 | 86,786 | 56,084 | 30.702 | 143,906 | 99.974 | 43.932 |
| Washington,......... | 11,594 | 8,450 | 3,144 | 23,955 | 18,931 | 5,024 | 75,120 | 59.259 | 15,861 |
| Wyoming. ........... | ......... | ......... | ......... | 9,118 | 5,605 | 3,513 | 20,788 | 14,943 | 5,845 |

## CITIES OF THE UNITED STATES HAVING MORE THAN 10,000 INHABITANTS IN 1880.

| Cities. | County. | State. | Total Population. | | Cities. | County. | State. | Total Populat'n. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1880. | 1870. | | | | 1880. | 1870. |
| New York.... | New York... | N. Y... | 1,266,299 | 942,292 | Indianapolis.. | Marion ...... | Ind.... | 75,056 | 48,244 |
| Philadelphia.. | Philadelphia. | Pa..... | 847,170 | 674,022 | Richmond .... | Henrico..... | Va..... | 63,600 | 51,038 |
| Brooklyn..... | Kings........ | N. Y.. | 566,663 | 396,099 | New Haven... | New Haven.. | Conn.. | 62,882 | 50.840 |
| Chicago.... .. | Cook.... .... | Ill..... | 503,185 | 298,977 | Lowell........ | Middlesex ... | Mass.. | 59,475 | 40,928 |
| Boston........ | Suffolk ...... | Mass.. | 362,839 | 250.526 | Worcester.... | Worcester... | Mass.. | 58,291 | 41,105 |
| Saint Louis... | .............. | Mo.... | 350.518 | 310,864 | Troy.......... | Rensselaer... | N. Y... | 56,747 | 46 465 |
| Baltimore .... | .............. | Md.... | 332.313 | 267,354 | Kansas City.. | Jackson..... | Mo.... | 55,785 | 32.260 |
| Cincinnati.... | Hamilton.... | Ohio.. | 255,139 | 216.239 | Cambridge.... | Middlesex... | Mass.. | 52,669 | 39,634 |
| San Francisco | S. Francisco. | Cal... | 233,959 | 149,473 | Syracuse...... | Onondaga .. | N. Y... | 51,792 | 43,051 |
| New Orleans. | Orleans...... | La.... | 216,090 | 191.418 | Columbus ... | Franklin .... | Ohio... | 51,647 | 31,274 |
| Cleveland..... | Cuyahoga.... | Ohio... | 160,146 | 92,829 | Paterson...... | Passaic...... | N. J... | 51,031 | 33.579 |
| Pittsburgh.... | Allegheny ... | Pa..... | 156,389 | 86 076 | Toledo........ | Lucas........ | Ohio... | 50.137 | 31.584 |
| Buffalo... .... | Erie....... | N. Y... | 155,134 | 117.714 | Charleston.... | Charleston .. | S. C... | 49,984 | 48.956 |
| Washington .. | .............. | D. C... | 147.293 | 109,199 | Fall River.... | Bristol ...... | Mass.. | 48,961 | 26.766 |
| Newark ... .. | Essex ....... | N. J... | 136.508 | 105,059 | Minneapolis .. | Hennepin. .. | Minn.. | 46,887 | 13,066 |
| Louisville .... | Jefferson.... | Ky.... | 123.758 | 100,753 | Scranton ..... | Lackawanna. | Pa..... | 45,850 | 35,092 |
| Jersey City. . | Hudson .... | N. J... | 120,722 | 82.546 | Nashville..... | Davidson.... | Tenn .. | 43,350 | 25,865 |
| Detroit ..... | Wayne...... | Mich .. | 116,340 | 79,577 | Reading. ..... | Berks ....... | Pa..... | 43,278 | 33.930 |
| Milwaukee.... | Milwaukee... | Wis. .. | 115,587 | 71.440 | Wilmington .. | New Castle.. | Del.... | 42,478 | 30,841 |
| Providence.... | Providence.. | R. I... | 104.857 | 68,904 | Hartford...... | Hartford..... | Conn.. | 42,015 | 37,180 |
| Albany........ | Albany...... | N. Y... | 90,758 | 69,422 | Camden....... | Camden. .... | N. J... | 41,659 | 20,045 |
| Rochester .... | Monroe...... | N. Y... | 89,366 | 62,386 | Saint Paul.... | Ramsey...... | Minn.. | 41,473 | 20,030 |
| Allegheny .... | Allegheny... | Pa..... | 78,682 | 53,180 | Lawrence. ... | Essex....... | Mass.. | 39,151 | 28,921 |

## CITIES OF THE UNITED STATES—Continued.

| Cities. | County. | State. | Total Population. 1880. | Total Population. 1870. | Cities. | County. | State. | Total Populat'n. 1880. | Total Populat'n. 1870. |
|---|---|---|---|---|---|---|---|---|---|
| Dayton | Montgomery | Ohio | 38.678 | 30,473 | Bangor | Penobscot | Me | 16,857 | 18,289 |
| Lynn | Essex | Mass. | 38,274 | 28,233 | Montgomery | Montgomery | Ala | 16,714 | 10.588 |
| Atlanta | Fulton | Ga | 37,409 | 21,789 | Lexington | Fayette | Ky | 16,656 | 14,801 |
| Denver | Arapahoe | Colo | 35,629 | 4 759 | Johnstown | Fulton | N. Y | 16,626 | ...... |
| Oakland | Alameda | Cal | 34,555 | 10,500 | Leavenworth | Leavenworth | Kan | 16,550 | 17,873 |
| Utica | Oneida | N. Y | 33,914 | 28,804 | Akron | Summit | Ohio | 16,512 | 10,006 |
| Portland | Cumberland | Me | 33,810 | 31,413 | New Albany | Floyd | Ind | 16,422 | 15,396 |
| Memphis | Shelby | Tenn | 33,592 | 40,2:6 | Jackson | Jackson | Mich | 16,105 | 11.447 |
| Springfield | Hampden | Mass | 33,340 | 26,703 | Woonsocket | Providence | R. I | 16.053 | 11,527 |
| Manchester | Hillsborough | N. H | 32.630 | 23,586 | Racine | Racine | Wis | 16.031 | 10.000 |
| Saint Joseph | Buchanan | Mo | 32.431 | 10,565 | Lynchburg | Campbell | Va | 15 959 | 6,825 |
| Grand Rapids | Kent | Mich | 32,016 | 16,507 | Sandusky | Erie | Ohio | 15,838 | 13.000 |
| Hoboken | Hudson | N. J | 30,999 | 20.297 | Newport | Newport | R. I | 15 693 | 12,521 |
| Harrisburg | Dauphin | Pa | 30,762 | 23,101 | Hyde Park | Cook | Ill | 15,716 | ...... |
| Wheeling | Ohio | W. Va. | 30.737 | 19,2:0 | Topeka | Shawnee | Kan | 15.451 | 5,790 |
| Savannah | Chatham | Ga | 30.709 | 28,2:5 | Oshkosh | Winnebago | Wis | 15,249 | 12,663 |
| Omaha | Douglas | Nebr | 30,518 | 16,088 | Atchison | Atchison | Kan | 15,1·6 | 7,054 |
| Trenton | Mercer | N. J | 29.910 | 22,874 | Chester | Delaware | Penn | 14,996 | 9.485 |
| Covington | Kenton | Ky | 29.720 | 24,5·5 | Lafayette | Tippecanoe | Ind | 14,860 | 13,506 |
| Evansville | Vanderburgh | Ind | 29.280 | 21,830 | Leadville | Lake | Col | 14,820 | ...... |
| Peoria | Peoria | Ill | 29,259 | 22,849 | La Crosse | La Crosse | Wis | 14.505 | 7.785 |
| Mobile | Mobile | Ala | 29,1:2 | 32,034 | Norwalk | Fairfield | Conn | 13,960 | 12,119 |
| Elizabeth | Union | N. J | 28.229 | 20,832 | Knoxville | Knox | Tenn | 13,928 | 8,682 |
| Erie | Erie | Pa | 27,737 | 19.646 | Concord | Merrimac | N. H | 13,838 | 12,241 |
| Bridgeport | Fairfield | Conn | 27.643 | 18,969 | Virginia City | Storey | Nev | 13.705 | 7,000 |
| Salem | Essex | Mass | 27,563 | 24,117 | New Lots | Kings | N. Y | 13 681 | ...... |
| Quincy | Adams | Ill | 27,268 | 24.052 | Schenectady | Schenectady | N. Y | 13 675 | 11.026 |
| Fort Wayne | Allen | Ind | 26,880 | 17,718 | Alexandria | Alexandria | Va | 13.688 | 13.570 |
| New Bedford | Bristol | Mass | 26,845 | 21,320 | Lockport | Niagara | N. Y | 13,522 | ...... |
| Terre Haute | Vigo | Ind | 26,042 | 16,103 | Newburyport | Essex | Mass | 13,537 | 21,595 |
| Lancaster | Lancaster | Pa | 25,769 | 20,233 | Nashua | Hillsborough | N. H | 13.397 | 10.543 |
| Somerville | Middlesex | Mass | 24,933 | 14,685 | Orange | Essex | N. J | 13.206 | 9.348 |
| Wilkesbarre | Luzerne | Pa | 23,339 | 10,174 | Little Rock | Pulaski | Ark | 13,185 | 12.380 |
| Des Moines | Polk | Iowa | 22,408 | 12,035 | Rockford | Winnebago | Ill | 13,135 | 11.049 |
| Dubuque | Dubuque | Iowa | 22,254 | 18,434 | Fond du Lac | Fond du Lac | Wis | 13,091 | 12.764 |
| Galveston | Galveston | Texas | 22,248 | 13.813 | Lincoln | Lancaster | Neb | 13,004 | 2.441 |
| Norfolk | Norfolk | Va | 21,966 | 19.229 | Chattanooga | Hamilton | Tenn | 12,892 | 6.093 |
| Auburn | Cayuga | N. Y | 21,924 | 17,225 | Macon | Bibb | Ga | 12.748 | 10 810 |
| Holyoke | Hampden | Mass | 21,915 | 10,733 | Richmond | Wayne | Ind | 12.743 | 9,445 |
| Augusta | Richmond | Ga | 21,891 | 15,389 | Biddeford | York | Me | 12,652 | 10.282 |
| Davenport | Scott | Iowa | 21.831 | 20,038 | Georgetown | Washington | D. C | 12.578 | 11.384 |
| Chelsea | Suffolk | Mass | 21,782 | 18.547 | San Jose | Santa Clara | Cal | 12,567 | 9,000 |
| Petersburg | Dinwiddie | Va | 21,656 | 18,950 | Fitchburg | Worcester | Mass | 12,405 | ...... |
| Sacramento | Sacramento | Cal | 21,420 | 16.253 | Canton | Stark | Ohio | 12.258 | 8.660 |
| Taunton | Bristol | Mass | 21.213 | 18.629 | Rutland | Rutland | Vt | 12.149 | 9,834 |
| Oswego | Oswego | N. Y | 21,116 | 20.910 | Hamilton | Butler | Ohio | 12,122 | 11.081 |
| Salt Lake City | Salt Lake | Utah | 20,768 | 12.854 | Keokuk | Lee | Iowa | 12,117 | 12.766 |
| Springfield | Clarke | Ohio | 20.730 | 12,652 | Rome | Oneida | N. Y | 12.045 | 11,000 |
| Bay City | Bay | Mich | 20,693 | 7,064 | Malden | Middlesex | Mass | 12,017 | ...... |
| San Antonio | Bexar | Texas | 20,550 | 12.256 | Easton | Northam'ton | Pa | 11.924 | ...... |
| Elmira | Chemung | N. Y | 20,541 | 15,863 | Aurora | Kane | Ill | 11,825 | 11,162 |
| Newport | Campbell | Ky | 20,433 | 15.087 | Vicksburg | Warren | Miss | 11,814 | 12,443 |
| Poughkeepsie | Dutchess | N. Y | 20,207 | 20,080 | Middletown | Middlesex | Conn | 11.731 | 6,923 |
| Springfield | Sangamon | Ill | 19,743 | 17,364 | Waltham | Middlesex | Mass | 11,711 | ...... |
| Watervliet | Albany | N. Y | 22.220 | ...... | Dover | Strafford | N. H | 11,687 | 9,294 |
| Norwich | New London | Conn | 21.141 | 16,653 | Galesburg | Knox | Ill | 11,446 | 10,158 |
| Waterbury | New Haven | Conn | 20.269 | 10,826 | Burlington | Chittenden | Vt | 11.364 | 14.387 |
| Portland | Multnomah | Ore | 20,149 | 8.293 | Portsmouth | Norfolk | Va | 11,390 | 10,492 |
| Cohoes | Albany | N. Y | 19,417 | 15,357 | Chicopee | Hampden | Mass | 11,525 | ...... |
| Lewiston | Androscog'n | Me | 19,083 | 13.600 | Portsmouth | Scioto | Ohio | 11.314 | 10,592 |
| Pawtucket | Providence | Mass | 19,030 | 6,600 | Los Angeles | Los Angeles | Cal | 11.311 | 5,727 |
| Gloucester | Essex | Mich | 19.329 | 15,387 | Attleboro | Bristol | Mass | 11.111 | ...... |
| East Saginaw | Saginaw | R. I | 19,016 | 11,350 | Hannibal | Marion | Mo | 11,074 | 10,125 |
| Burlington | Des Moines | Iowa | 19,450 | 14,930 | Shreveport | Caddo | La | 11.017 | 4.600 |
| Williamsport | Lycoming | Penn | 18,934 | 16,030 | Austin | Travis | Texas | 10.960 | 4,428 |
| Yonkers | Westchester | N. Y | 18,892 | ...... | Chillicothe | Ross | Ohio | 10,9:8 | 8 920 |
| Houston | Harris | Texas | 18.646 | 9,382 | Jacksonville | Morgan | Ill | 10,927 | 9,203 |
| Haverhill | Essex | Mass | 18,475 | ...... | Saratoga Sp'gs | Saratoga | N. Y | 10,822 | ...... |
| Lake Towns'p | Lake | Ill | 18,396 | ...... | Watertown | Jefferson | N. Y | 10,697 | 9.336 |
| Kingston | Ulster | N. Y | 18,342 | ...... | Weymouth | Norfolk | Mass | 10.571 | ...... |
| Meriden | New Haven | Conn. | 18.340 | 10.495 | New London | New London | Conn | 10.529 | 9.576 |
| Zanesville | Muskingum | Ohio | 18,120 | 10,011 | Dallas | Dallas | Tex | 10,358 | 5.000 |
| Newburg | Orange | N. Y | 18,050 | 17 014 | Ogdensburg | St Lawrence | N. Y | 10,340 | 10.076 |
| Allentown | Lehigh | Pa | 18,063 | 13,884 | Madison | Dane | Wis | 10.325 | 9.176 |
| Council Bluffs | Pot'watomie | Iowa | 18,059 | 10,020 | Stockton | San Joaquin | Cal | 10,287 | 10.966 |
| Wilmington | New Hanover | N. C | 17,361 | 13.446 | Winona | Winona | Minn | 10,208 | 7.192 |
| Binghamton | Broome | N. Y | 17,315 | 12.692 | North Adams | Berkshire | Mass | 10,192 | ...... |
| Bloomington | McLean | Ill | 17,184 | 14,590 | Eau Claire | Eau Claire | Wis | 10,118 | ...... |
| L'ng Isl'd City | Queens | N. Y | 17,117 | ...... | Cedar Rapids | Linn | Iowa | 10.104 | 5.940 |
| N. Brunswick | Middlesex | N. J | 17.167 | 15,058 | Columbia | Richland | S. C | 10.040 | 9,298 |
| Newton | Middlesex | Mass | 16,996 | ...... | Columbus | Muscogee | Ga | 10,123 | 7,401 |

# COTTON CULTURE.

Cotton has been for many years one of our great staples of production and export. Before the civil war it was often declared to be the crop of greatest money value in the country. This declaration was disputed, and probably correctly, on behalf of the Indian corn and the hay crops. Since the war, the wheat crop has also exceeded it in value, although the cotton crops of the last four years have exceeded in quantity the largest ever produced in our previous history.

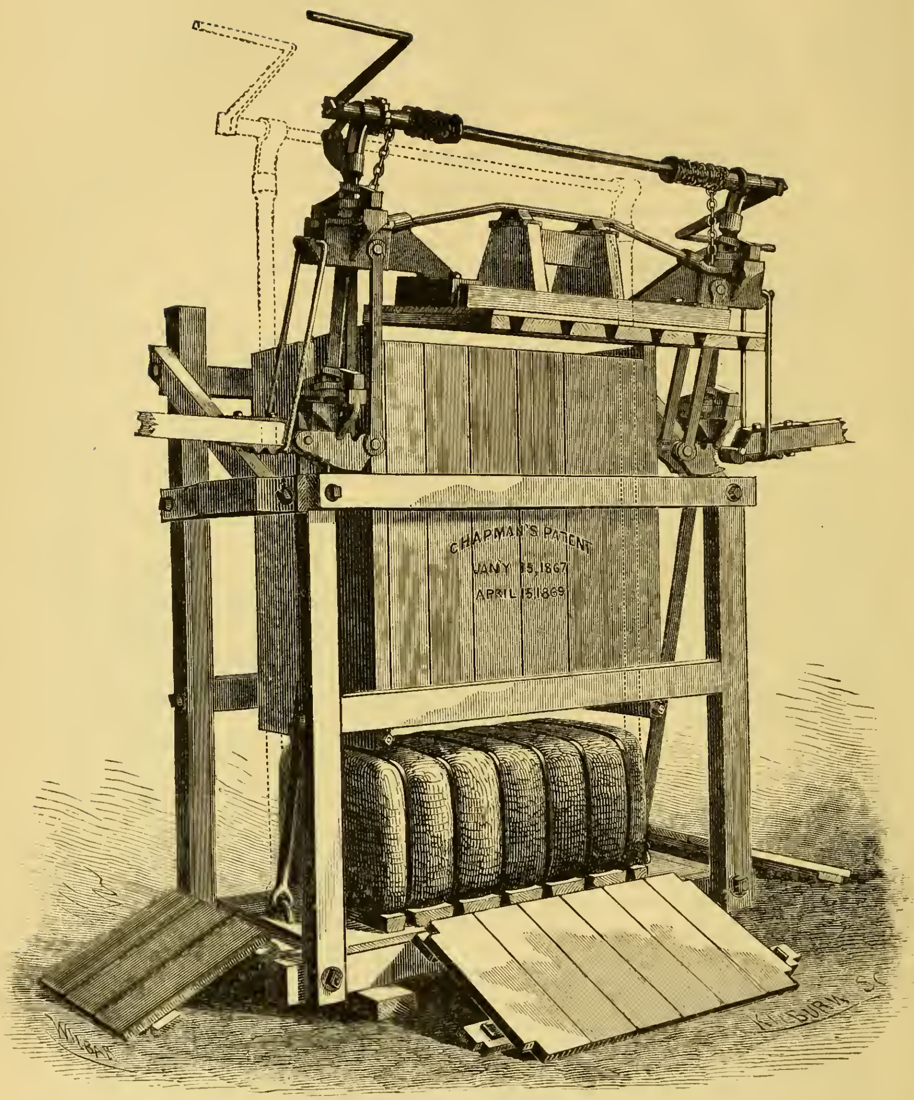
There is no question, however, that its *exports* reached a greater value, before the war, than those of any other crop, or class of crops raised in this country. They did not retain this superiority during the war, but regained it soon after, and continued to hold it until the fiscal year 1877–78, when breadstuffs took the lead, which they have since continued to hold. In 1879, 1880, and 1881 the export of wheat and wheat flour alone exceeded that of cotton. While this is true, it is also true that the actual production of cotton has been greater during the past four years than at any period in our national history, and though prices have ruled low, there is a fair prospect of an increasing demand both at home and abroad, which will absorb, at remunerative prices, a still larger production. For the present, however, the object to be desired is not so much an increase in the aggregate production of cotton, as the production of a crop of, say, 6,500,000 bales from one-half the land which is now planted in cotton. In 1879, a year of more than average production, the average yield per acre of all the cotton states was but 174 pounds, a little more than a third of a bale to the acre. Now there is no land planted in cotton, which ought not, with reasonably fair manuring and cultivation, to produce, in an average year, at least one bale—480 pounds—of good cotton to the acre and there are many scores of thousands of acres which can easily yield two bales to the acre. The crop of 1879 was gathered from 12,595,500 acres. It ought to have been grown on five million acres at the utmost, and would then have left 7,595,500 acres for other profitable crops, and thus have added more than a hundred million dollars to the productive wealth of those states for that year, without tilling a single acre more than was tilled for cotton.

But that we may fully understand what is comprehended in the successful cultivation of cotton, let us sketch briefly its history and the processes of its production.

The first mention of cotton is made by Herodotus about 450 B. C. He refers to its cultivation in the east, but seems to have had no very definite knowledge of it. Four hundred years later Strabo, writing of India and its productions, said: "There grows in that land a tree, called the cotton tree, which bears a kind of wool, from which fine linen is made." His ideas were a little mixed, but there could be no possibility of mistaking that the "tree cotton," which still grows in some parts of the east as well as in South America, is the tree or shrub to which he referred. It is a native of the East Indies, and possibly also of Africa, and of America; it has been grown in Africa from time immemorial, and was found, growing and utilized by the natives of Hispaniola, by Columbus in 1492. Manufactures of cotton were not probably attempted in Europe earlier than the tenth century, but in India and China cotton goods were undoubtedly made before the Christian Era and perhaps in Africa also.

Cotton was found growing in the lower Mississippi Valley, in California, and in what is now Texas, in 1536, but its cultivation by white people is said not to have been attempted before 1621. Three species of the plant were noted at this time, the tree cotton, which lasts 20 years or more, the shrub, which has a life of three or four years, and the annual *gossypium album* and *nigrum*, now cultivated in the U. S. In

HAULING COTTON TO MARKET




CHAPMAN'S COTTON PRESS.

Cotton, after reaching the shipping port, is re-bailed, being compressed into as small a compass as possible, in order to stow away to the best advantage in the hold of the ship.

1736 the cotton plant was known on the eastern shore of Maryland, in Delaware and elsewhere in the Middle States, but it was grown mainly as an ornamental plant, and its culture was confined to gardens. In 1739 a bale of cotton was exported from Savannah, Georgia, to England, and it was cultivated with a view to its utilization in South Carolina about the same time. There was, however, but little grown, and certainly very little exported, until after the Revolution. In 1784 an American ship from Charleston landed eight bales of cotton from that port at Liverpool, and was immediately seized charged with having false bills of lading, on the ground that so much cotton could not have been produced in the United States. In 1785, the cultivation of the green seed or short staple cotton (*gossypium album*) was commenced in the United States on a considerable scale, having been introduced into Georgia, it is said, from the West Indies; ten years later, a million pounds were exported from Charleston to England. Previous to 1785, most of the cotton raised in what was then the extreme south, was the black seed, long-staple, or sea-island cotton, which could only be grown in low and moist lands, with a very equable climate. This kind of cotton, which is very valuable for many purposes and commands a very high price, is still grown on the coast of South Carolina, Georgia, Florida, and Texas, and about five million pounds are annually exported. The upland green-seed or short-staple cotton was slow in becoming a general crop in the southern states. In 1791 only 2,000,000 pounds were raised and 189,500 pounds exported. There was great difficulty in freeing this variety from its seeds which were then considered useless. In 1793, Eli Whitney, then a teacher near Savannah, Georgia, invented the saw cotton-gin, which though a source of little profit and of constant litigation to him, immensely increased the cotton production. Previous to this only a roller-gin had been made, which though sufficient to free the long-staple cotton from its seeds, was worthless on the short-staple cotton, to which the seeds adhered very closely.* The impulse which was imparted to cotton production by this invention is seen in the fact that in 1803, only ten years after the first gin was made, the export of cotton was 41,000,000 pounds and nearly 3,000,000 pounds were retained for home consumption. In 1810 the exports had increased to 94 million pounds, and the home consumption to about six million pounds. In 1820, the production was about 171 million pounds and the export 128 million pounds. The production and export increased steadily and rapidly; in 1830 the production was about 350 million pounds and the export, 271 million; in 1840, production 744,000,000 pounds, export 621,000,000 pounds; in 1850, the production was 800 million pounds the home consumption 240 millions, and the export 560 million pounds. In 1860, the crop was the largest which had ever been grown up to that time, aggregating 2,275,372,309 pounds, of which 509,547,229 pounds were retained for home consumption and 1,765,825,080 pounds were exported. Then came the war, during which production was much diminished, and exports were reduced to a minimum. The whole export of the five years, 1861–5, was but 350 million pounds and 307,634,242 of this was in 1861 before the war was fairly inaugurated. For four years after the close of the war the production did not rise above 1,173,000,000 pounds, about one-half that of the crop of 1860, and the exports ranged from 645 million to 785 million pounds; but the increase began with 1870, when the production rose to 1,451,401,357 pounds and the exports to 958,785,304 pounds, and the advance has continued till in 1876, it had nearly equaled the great crop of 1860, being 2,157,958,142, about two-thirds of which was exported; and in 1880 reached 2,771,797,156 pounds, five hundred million pounds more than 1860, and the export was 1,822,295,843 pounds, while the amount retained for home consumption was 953,049,105 pounds. Meanwhile, however, the price had decreased till if valued at the price at which the exported cotton was estimated in New York and New Orleans, 11.5 cents, it would have been worth only $306,283,585.73, which after deducting the cost of putting the crop on the market, is possibly less than the actual cost to the producers. We say, possibly, because the cost of raising a pound of cotton varies in different

*Various modifications have been made in the Whitney cotton-gin, in the almost ninety years since its invention, but all of them have retained his fundamental principle of the necessity of saw teeth to detach the seeds; and their construction witnesses to the cruel injustice which was done to him in pirating his invention, and denying him any compensation for it.

states. In Georgia for several years past it has averaged even among the most successful cotton planters, and counting the most favorable seasons, 12.5 to 13 cents. The cost in Alabama, Mississippi, and Tennessee does not probably exceed 12 cents. In South Carolina it averages 13.1. In Texas and Arkansas it is claimed that it does not exceed 11.2 cents. When we consider that the price named (11.5 cents) was that received at the shipping ports, and that it included interest on advances made to the planters, the transportation and freight to the ports of shipment, the cotton buyers and the bankers' commissions we can easily understand that eleven and a half cents at the shipping port means not over eight or eight and a half to the planter. There is, then, taking one year with another, a dead loss to the planter of from 25 to 40 per cent. on his cotton crop, though this may be somewhat diminished by the now recognized value of the cotton seed for its oil, its oil cake, and for manure. But a continuous loss of even 10 per cent. on the principal crop of the planter, will in ten years' time sweep away his entire plantation.

What are the remedies for this condition of affairs? There are two, and only two, of any importance; viz.: to increase the yield of the land, by manuring it thoroughly and cultivating it carefully and skilfully, till the lowest yield shall be two bales to the acre instead of a third or fourth of a bale as now. It will require fewer hands to raise and pick two bales to the acre than it will to raise the same quantity from six acres. 2. The other remedy is to abandon cotton planting wholly or in part, and turn the principal attention to the cultivation of other crops which will pay better, and with less labor. What these crops shall be depends much upon the location of the planter. In South Carolina and Georgia, they may be corn, sorghum, wheat, potatoes, and in the lowlands rice and sweet potatoes. In Florida, rice, oranges. lemons, and perhaps some sugar; in Mississippi and Alabama, corn, Irish and sweet potatoes; in Tennessee and Arkansas, fruits, corn, wheat, potatoes, and oats; in Texas sugar, sorghum, corn, oats and wheat and fruits; in Louisiana, sugar, rice, corn, fruits, and sweet potatoes. In all the States, in the vicinity of cities and large towns, market vegetables and small fruits. Forage and the forage grasses should be cultivated far more extensively than they are, and if the system of ensilage were adopted, ten times the present number of domestic animals might be kept with but little labor, and the quantity of manure thus obtained would permanently enrich the land and save the very large outlay for guano, superphosphates and other artificial manures, while it produced much more beneficial results. The substitution of stable and barnyard manures well composted, for the costly artificial manures, would reduce the cost of cotton more than two cents a pound, and give every year a better crop. The English plan of folding sheep upon turnip fields, is to be commended both for the sake of the sheep, and for the enrichment of the land. Much of the land in the southern states, though a light sandy loam, is capable of yielding great crops, by the aid of good and permanent manures, and will retain such manures so as to be constantly growing richer.

Let us look at the present method of growing cotton in the south and find out, if we can, in what way it can be improved so as to make the agricultural crops, and especially cotton, which will probably always be a large crop, profitable.

In the old days of slave labor, the methods of cultivation of cotton, were very slovenly and ruinous. The cotton lands, generally a light loamy soil, like that of most of the arable lands of the south, were scratched over with a light plow, not penetrating to a depth of more than two inches, and the furrows turned over each way so as to make ridges on the unplowed portion; these ridges were generally from five to nine feet apart to allow of ploughing between, and were pretty well pulverized by the hoe, though to no great depth, and the cotton seed either dropped by hand or by drill pretty freely, often to the extent of ten bushels or more to the acre, in a slight furrow opened at the top of the ridge. No manure was used, though cotton is an exhausting crop; nor was there rotation of crops, but the same plots of ground were sown to cotton as long as there was sufficient nutriment in the soil to enable the cotton plant to rise above the weeds, and make what was technically called "a stand;" and when the land was too much exhausted for this, and would not yield even 30 or 40 pounds of ginned cotton to the acre, it was abandoned and if the planter had other lands, they were put through the same process, while the abandoned lands were left to be overrun with scrub oak, juniper and sumac bushes, if it could sustain them, and if not, to be a barren waste for years to come. These exhausted lands are not easily restored to fertility, and their prevalence in all the older states of the south is a reproach to southern agriculture. When the planter had exhausted his plantation, he sold it, if he could, for a trifle, or if he could not sell it abandoned it and sought in Mississippi, Texas, or Arkansas for new lands to be subjected to the same wasteful processes.

But we are leaving our newly sown cotton to its enemies, let us return to it. The soil of the ridges needed very thorough pulverization, and generally received it, though by the hoe only. The planting season was usually from the first to the fifteenth of April, the more careful planters having commenced plowing and pulverizing the soil as early as the 20th of February. The cotton plants did not generally appear above the surface under nine days after planting. The plants usually came up very thickly and were thinned out by the hoe, or sometimes by hand, leaving at first clumps or bunches twenty inches or two feet apart. A little later these were again thinned out, the weaker plants being chopped out with the hoe, till the bunches were reduced to two, and finally to one plant; and meantime, the space between the rows was scraped by a light plow to kill the grass and weeds and keep the ground soft around the plants. Cotton is at first a very tender plant, and requires great care, but if the soil is good and easily penetrated, it soon thrusts down a long tap root, and becomes a vigorous shrub. The necessity of keeping out the grass from between the rows and around the plants. kept the working force of the planter well employed for two or three months. As the plants attained their height and the buds and blossoms began to appear, the enemies of the cotton plant became visible, though they mustered their strongest force when the boll was fully formed. The most formidable of these were, and still are, the cotton worm and the boll-worm. Like all the caterpillar tribe these appear first as the moths, laying their thousands of eggs, next as a minute worm, hatched from these eggs, and growing into a large and voracious caterpillar, which devours the leaves, the blossoms, and the bolls of the cotton plant, and having done its mischief, rolls itself in a fragment of the leaf and spins its silken cocoon, from which, after a few days, it emerges as a moth or butterfly to go through the same changes again. In the portion of the southern states lying on or near the Gulf there are three broods of these pests in a single season, the third being altogether the most numerous and destructive. The loss from these insects is estimated by careful observers at from 600,000 to 800,000 bales of cotton annually, or from one-eighth to one-sixth of the whole crop. Almost every known means has been resorted to for ridding the cotton fields of these pests, the use of poisons wet and dry; the lighting of fires, the use of traps of poisonous sweets, the encouragement of parasitic and other insect enemies, and of insectivorous birds, and in the early stages picking them off by hand, but the destruction from their ravages continues, though much less prevalent in some years than others.

If, however, the cotton plant escapes these numerous foes, and the boll attains its growth, and gradually bursts its integuments and opens its wealth of cotton, it is a beautiful sight, in its fleecy purity. But at this point there came to the planter in the old days, his hurrying time. Cotton picking was fortunately extended over a considerable period; there was the first picking, when the earliest ripened bolls had burst, a second picking, when the greater part of the crop was opened, and when the greatest activity was necessary to prevent the cotton from being wasted or injured or stained by rains or heavy dews, or soiled by being trampled in the dirt. A third picking took place later, and gathered the cotton from the late bolls, some of which only open after frost has killed the plant. If the plantation was large, the gin-house and cotton press were near the cotton fields, and the baskets of seed cotton were carried there at once, dried, ginned and pressed ready for shipment to the great shipping ports, where it was repacked, and strapped with iron for exportation. Four pounds of seed cotton were required to make one pound of ginned cotton, and the average yield per acre did not exceed 150 pounds of ginned cotton.

Since the war, and especially since 1875, there has been a marked change for the better in cotton culture. It is doubtful whether cotton can be raised quite as cheaply now as twenty-five years ago, but this is the case with some other crops also. The labor of the freedmen is now probably about as efficient as the slave labor ever was, though the labor of the women and children may not be utilized to the same extent; but cotton picking is quite as well and more intelligently done than formerly, and this is also true of most agricultural operations. The slave could not be taught to use agricultural machinery with any skill; the freedman can; and the cultivation of the soil, from the greater agricultural knowledge of the planters and the increased intelligence of the employees is far in advance of the slovenly farming before the war. The ploughing is not yet so deep as it should be, and barren lands are not restored to their ancient fertility to a very large extent; but the use of manures has increased a hundred-fold, and though they are yet mostly of the costly kind, such as guano, the rock phosphates, superphosphates, nitrates and other artificial manures, and will not produce so permanent effects as those produced and composted on the farm, at a much lower cost, yet they do in a considerable degree restore to the soil the elements which are drawn from it in the culture of cotton. The use of the cotton-seed in compost, as a manure, was a very judicious measure as it contained the very elements which the land needed, but the great and constantly increasing demand for cotton-seed for grinding for oil and oil cake, renders it much more expensive than formerly. Still that large portion of it, which is not fit for the mills, may be utilized as manure to good advantage. The rotation of crops is practiced to a much greater extent than formerly, and with good results. If the southern agriculturists could be persuaded to keep more live stock, and raise forage grasses and plants to feed it, they would find their farming altogether more profitable. A greater diversity of crops would be an advantage in many ways. They would not lose everything by a failure of one crop, for if they raised corn and sorghum, wheat, barley, potatoes, and fruits, as well as cotton, and had large numbers of horses, cattle, milch cows, sheep, and swine, the failure of the cotton crop or the corn crop would not reduce them to bankruptcy. By rotating the crops and constantly enriching their lands they would soon be able to make two bales of cotton to the acre (some of them even now are making five bales to the acre), in an average season, and by doing this they can send as much cotton to market from fifty acres as they now do from 200 or 250. It is certainly worth an effort. There seems to be no good reason why, raising as we do the best cotton in the world, we should not supply the world with it, and this without interfering with the other crops which we are producing in so large quantities. The consumption of cotton throughout the world—at least so much of it as comes into the markets of the world, does not quite reach 13 million of bales. In 1879 and 1880 we produced about one half of the whole—on about 17,000,000 acres. In 1890 we ought to be able to produce 13,000,000 bales on less than half that quantity of land. Let us work with that result in view. With one or two items respecting the picking of the cotton, we close these suggestions to the cotton grower. It has always been a subject of complaint among manufacturers, that the teeth of the gins broke, tore, and slivered the delicate fibres of the cotton and that in consequence the cotton was not in as good condition for manufacturing, and did not yield as elegant and silky fabrics, nor those which were as durable as they would be if the cotton could be separated from its seeds by a less violent method. The adhesion of the seeds of the green-seed or short-staple cotton to the fibers is so strong, however, that the accomplishment of so desirable a result seemed impracticable. Within the past decade a machine has been invented which to some extent obviated this difficulty. It was a spinning machine which took the cotton directly from the field or from the gin-house, with the seeds unseparated from it and spun it with its bright silky fibres, pushing out the seeds and drawing the cotton away from them till they fell upon the floor, or into a hopper underneath the machine. The negroes described it very graphically when they said: "it chewed up the cotton and spat out the seeds." Whether this machine has gone into very extensive use in the south or not, we are not informed; the chances are against it, for it was intended mainly for use near the cotton plantations; and the southerner, as a rule, is averse to manu-

PICKING COTTON.

The season of cotton picking commences in the latter part of July, and continues without intermission to the Christmas holidays. The work is not heavy, but becomes tedious from its sameness. The field hands are each supplied with a basket and bag. The basket is left at the head of the "cotton-rows;" the bag is suspended from the "picker's" neck by a strap, and is used to hold the cotton as it is taken from the boll. When the bag is filled it is emptied into the basket, and this routine is continued through the day. Each hand picks from two hundred and fifty to three hundred pounds of "seed cotton" each day, though some negroes of extraordinary ability go beyond this amount.

If the weather be very fine, the cotton is carried from the field direct to the packing-house; but generally it is first spread out on scaffolds, where it is left to dry, and picked clean of any "trash" that may be perceived mixed up with the cotton. Among the most characteristic scenes of plantation life i the returning of the hands at nightfall from the field, with their well-filled baskets of cotton upon thei heads. Falling unconsciously "into line," the stoutest leading the way, they move along in the dim twilight of a winter day, with the quietness of spirits rather than human beings.—*Harper's Magazine.*

GATHERING THE CANE.

And now may be seen the field-hands, armed with huge knives, entering the harvest field. The cane is in the perfection of its beauty, and snaps and rattles its wiry-textured leaves as if they were ribbons, and towers over the head of the overseer as he rides between the rows on his good-sized horse. Suddenly, you perceive an unusual motion among the foliage—a crackling noise, a blow—and the long rows of growing vegetation are broken, and every moment it disappears under the operation of the knife. The cane is stripped by the negroes of its leaves, decapitated of its unripe joints, and cut off from the root with a rapidity of execution that is almost marvellous. The stalks lie scattered along on the ground, soon to be gathered up and placed in the cane-wagons, which with their four gigantic mule-teams have just come rattling on to the scene of action with a noise and manner that would do honor to a park of flying artillery.

We have already alluded to the fact that the sugar crop has to be gathered in Louisiana within ninety days, or else it will be destroyed by the cold; as a consequence, from the moment the first blow is struck, every thing is inspired with energy. The teams, the neg oes, the vegetation, the very air, in fact, that has been for months dragging out a quiescent existence, as if the only object of life was to consume time, now start as if touched by fire. The negro becomes supple, the mules throw up their heads and paw the earth with impatience, the sluggish air frolics in swift currents and threatening storms, while the once silent sugar house is open, windows and doors. The carrier shed is full of children and women, the tall chimneys are belching out smoke, and the huge engine, as if waking from a benumbing nap, has stretched out its long arms, given one long-drawn respiration, and is alive.—*Harper's Magazine.*

facturing, and has very little capital which he is disposed to spare from his plantation to put into manufacturing operations. We do not despair, however, of hearing as the outcome of this machine some modification of the gin which shall pull the cotton from the seeds instead of tearing it to slivers in removing them. The seeds are so heavy that only one pound of ginned cotton is produced from four pounds of seed cotton. The demand for the seeds for the production of the cotton-seed oil and oil cake is very great, and as yet far beyond the supply; much of this goes to Europe and especially to England and France; in the latter country it is said to be used largely in the production of *pure olive oil!* and it is averred that it is less liable to become rancid than the genuine oil. The oil cake is preferred to that produced from linseed in Europe. It is not impossible in these days of wondrous inventions that an efficient and economical cotton picker (perhaps one of Jules Verne's steam men or steam elephants), may be devised which shall effectually and rapidly remove the cotton from the plants and perhaps separate it from the seeds, as it moves along. Such an invention would be invaluable to a cotton planter, if it could accomplish its work well; but it would doubtless receive strong opposition from the laboring classes, white and black, in the south, to whom cotton picking, though very hard work, is looked forward to as a season of great enjoyment and jollity.

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# SUGAR—CULTIVATION AND CONSUMPTION.

## I. Cane Sugar.

The cultivation of cane sugar in the United States has become of considerable importance only in the last ten years. While it has in that time occupied an increasing proportion of the attention of the planters of Texas and Louisiana, it has rather declined in other portions of the Southern states. The cane itself is more nearly associated with Indian corn in the general character of its climatic requirements than any other staple. It differs from corn in this respect only in degree, each condition, or the principal condition of temperature, at least, being required in similar, but greater tropical excess for the period of its growth. In the southern parts of the United States the great heat of summer gives this plant a range it attains in no other country of the same mean annual temperature; and it is restrained only by the limit of its safe endurance of the winter. The cane may be cultivated east of the high plains and deserts of Texas, and south of 34° north latitude. The area now occupied by the cane is quite limited, a part of Texas, the lower parishes of Louisiana, a portion of Florida, in the latitude of Tallahassee to Cedar Keys, and the Atlantic coast of Georgia, comprising its extent. The considerable capital required to conduct the culture makes it a larger interest than might be inferred from this limited extent of area.

The cane was first introduced into Louisiana in 1751, and the first plantation was established by Mr. Dubreul in 1758, a little more than a century since. The progress was not rapid, however, until 1794, when the revolution of St. Domingo drove some few Frenchmen to fly for refuge from their burning houses and their frantic pursuers on board American vessels, with such of their faithful slaves as would follow them. When there, they naturally turned their hopes to Louisiana, where they might find a home for themselves and their servants among kindred French. To these unhappy men Louisiana owes the introduction of the Creole cane, a small yellow kind, which only was then grown in the French islands. About the same period the cane culture was introduced into Georgia. There had been there growing and flourishing from the time of the first settlement of the country by General Oglethorpe, luxurious orange trees. As similar trees in Louisiana had been destroyed by the frost, while those in Georgia flourished uninjured, the idea was suggested to an enterprising planter that if under such circumstances cane would grow in Louisiana it would also grow in Georgia. In 1805 he procured 100 plants of the Otaheite cane that had been sent by Lieutenant Bligh from Otaheite. These 100 canes multiplied to 2000, and from these most of the plantations in Georgia and Florida were propagated. The question of labor in the English West Indies was then sufficiently discussed to induce many planters to leave Jamaica for new settlements, and many were attracted to Georgia by the luxuriant growth of the cane. The price of sugar was then, under the embargo, about ten cents per pound, and many plantations were established. The canes spread up the Altamaha, the Oconee, and the Ocmulgee, and luxuriated in the fine lands of Florida and Georgia to a distance of 150 miles from sea. Nevertheless, the manufacture was not many years after mostly abandoned in that region on a large scale or for export, but it is still conducted to a considerable extent for plantation and home use. It did not there pay so well as rice or cotton, since the product per acre was less than half what it had risen to be in Louisiana. In the rich lands of that state and Texas the product per acre is 2400 pounds against 1000 pounds even in the richest river lands of Georgia.

There are five kinds of cane in use by the planters of Louisiana, viz., the *Bourbon*, which has large eyes, a dark purple color, and is very hardy; the *green ribbon* is of a bright yellow color, with delicate green stripes; the eye is small, elongated, and delicate in its structure; the *red ribbon* has purple stripes of an inch or less in width, and can resist light frost; the *Otaheite* has large joints, does not grow high, and has a comparatively thin skin, and is easily affected by the frost, yet its juice is rich and abundant; the *Creole cane* yields a superior kind of sugar, but it has been less used than the Bourbon on account of its less hardy nature. It is now getting more into favor again. These are the varieties mostly used in Louisiana. The mode of culture is simple and allied to that of Indian corn. The canes are propagated by cuttings, and these are planted in the fall, seldom as early as October, since the planters have no time until the grinding season is over. The riper portion of the stalk is generally used for cane seed; others cut the cane in the middle and use the green tops for planting. The land is well ploughed, harrowed, and marked off in rows three to five and even eight feet apart. As the cane must reach its full growth in nine months, a good distance apart is thought necessary to promote access of the sun and the circulation of air. A double-mould-board plough follows the marker, opening a clear furrow for planting. In the furrow the canes are laid straight in such a manner that the eyes may freely throw out their shoots. They are covered from four to six inches. The young plants are cultivated much as Indian corn, in rows. The planting is done in some parts of Louisiana once in three years. The first year it is called "plant cane," and the subsequent growths are called rattoons. But sometimes, as on the prairies of Attakapas and Opelousas and the higher northern range of its cultivation, it requires to be replanted every year. Within the tropics, as in the West Indies and elsewhere, the rattoons frequently continue to yield abundantly for twelve, fifteen, and even twenty-four years from the same roots. In Louisiana in the fourth year the land is put in corn and peas. After the corn is gathered the stalks and peas are ploughed in, and the land is ready for cane again.

In Louisiana the cane never ripens, and therefore is allowed to grow as long as it can be done with safety from frost. In the latter part of October, they commence by saving their seed, that is, by cutting the cane they need for planting, and securing it by placing it in mats, so called, on the ground, say twenty feet by forty, resting it on an embankment, with the buts on the ground at an angle of about twenty degrees, and leaving a mass of tops on the surface, a foot deep and forming a perfect protection from frost.

Next they commence taking off the crops. Every negro has at all times in his possession a cane knife, like a butcher's cleaver, and kept very sharp. With the back of the knife he knocks off the dry leaves, and cuts off the stalk as of no value where the leaves are green. Should a frost come whilst they are making sugar, the work is stopped, and all hands are employed winnowing the cane in the fields, as a fermentation commences immediately, if it is allowed to stand.

The cane is as certain as any large crop we have. When the cane is gathered it is prepared for the mill. These are some twelve feet from the ground, in order that the juice may flow from the rollers into the juice boxes, and from them into the kettles. The mills are composed of three iron rollers from twenty-five to twenty-eight inches in diameter, and from four to five and a half feet long. There are a great number of inventions that have been patented within a few years. The cane carrier is an endless belt, fifty to ninety feet long, formed of chains, with slats inserted and placed at an angle of thirty to thirty-five degrees to the ground. The lower end is about two feet from the ground. On this the canes are spread evenly, and by its revolution they are carried up to the rollers which express their juice as they pass through. The juice thus obtained is collected in large reservoirs, to go through a process of boiling which has been greatly varied by improvements upon the old Creole plan. The juice, by boiling and evaporation, is reduced to the state of muscovado, which is placed in hogsheads with holes bored in the bottom, to permit the molasses to pass off. In the course of the boiling, lime is added in prepared portions to "defecate" the sugar, and the juice is bleached by passing through a filter of bone-black. Very many inventions have been patented for kettles, vacuum pans, etc., to facilitate the boiling process, and others to promote the discharge of the molasses. One of these is by centrifugal force. The sugar is placed in a cylinder of iron network, which, revolving with great rapidity, imparts to the molasses a centrifugal motion that drains it from the sugar through the net, when it is collected in proper vessels.

The introduction of bisulphate of lime of late years has added greatly to the quantity of sugar that may be obtained from a given quantity of cane, and also to its quality.

The quantity of sugar produced on an acre varies from 500 lbs. to 3,000 lbs; the average may be 1,000 lbs. A well-cultivated plantation in Louisiana produces 2,400 lbs. sugar and 2,000 lbs. or 160 gallons molasses per acre. Some mills will turn out 1,000 gallons juice per hour, twenty hours in a day, giving ten hogsheads of sugar, or 12,000 lbs. and 20 bbls. molasses, or 800 gallons, 12 lbs. to the gallon. The expenses and products of a plantation in Louisiana have been given as follows in official documents:—

| | | |
|---|---|---|
| Household Expenses, | | $1,000 |
| Overseer's salary, | | 400 |
| Food and clothing—15 working hands at $30, | | 450 |
| " " " 15 old hands and children, $15. | | 225 |
| Repairs, 1½ per cent. on capital ($40,000), | | 600 |
| | | $2,675 |
| 50 hhds. sugar at 4 cents per lb., | $2,500 | |
| 25 " " " 3 " " | 862 | |
| 25 " " " 2 " " | 575 | |
| 4,000 gals. molasses, 10 cents, | 400— | 4,137 |
| Balance, | | $1,462 |

There were many other products raised by the hands besides sugar. Thus there were in Louisiana 200,000 hands, and these produced, in 1859, 362,296 hhds. of sugar, worth with the molasses $31,399,241; and in addition they raised 6,327,882 bushels of corn, or 31 bushels per head; and 4,911,680 lbs. of rice, or 24½ lbs. per head. There were at that time in Louisiana 1,298 sugar houses, 987 worked by steam and 311 by horse power. The hogshead of sugar is a very variable measure, but the average weight, by the best authorities, is 1,150 lbs. As the population and business of the country increased, higher hopes were entertained of obtaining the national supply of sugar and molasses from Louisiana and the adjacent states in which the sugar cane could be cultivated by the layering process. These hopes were destined to be disappointed. Between 1826 and 1862 there were 19 years in which the domestic production equaled or exceeded the imports, and in a few of these years was largely in excess of them—but in all the remaining years it was far below them, and since 1862 it has been only from one-fifth to one-eighth. The following table shows what was the entire domestic production of cane sugar and molasses according to the censuses of 1860 and 1870:

| STATES. | 1860. | | 1870. | |
|---|---|---|---|---|
| | Sugar, lbs. | Molasses, gallons. | Sugar, lbs. | Molasses, gallons. |
| Alabama, | 201,250 | 85,115 | 35,650 | 166,009 |
| Arkansas, | .......... | .......... | 105,800 | 72,008 |
| Florida, | 1,919,350 | 436,357 | 1,094,800 | 344,339 |
| Georgia, | 1,342,050 | 546,749 | 740,600 | 553,192 |
| Louisiana, | 254,984,900 | 13,439,772 | 92,812,900 | 4,585,150 |
| Miss., | 581,900 | 10,016 | 56,350 | 152,164 |
| Missouri, | 462,300 | 22,305 | 56,350 | .......... |
| N. Carolina, | 43,700 | 12,494 | 40,250 | 33,888 |
| S. Carolina, | 227,700 | 51,041 | 1,213,250 | 436,882 |
| Tennessee, | 2,300 | 2,830 | 1,621,500 | 3,629 |
| Texas, | 5,973,850 | 408,358 | 2,323,000 | 246,062 |
| Totals, | 265,739,300 | 14,963,966 | 100,100,450 | 6,593,323 |

The following table shows the quantity of cane sugar and molasses imported, and the production in the United States as well as the special production of Louisiana, the number of pounds consumed per head, the price per pound, and the total estimated value of the amount consumed for different years from 1790 to 1880:

IMPORTATION, PRODUCTION, AND CONSUMPTION OF SUGAR AND MOLASSES IN THE U. S.

| Year. | Imports of Sugar. | Imports of Molasses. | Domestic Production of Sugar. | Domestic Production of Molasses. | Louisiana Sugar Product. | Louisiana Molasses Product. | Pounds per head. | Price per lb. | Value of Total Consumption. |
|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Gallons. | Pounds. | Gallons. | Pounds. | Gallons. | | Cts. | Dollars. |
| 1790 | 18,229,419 | 5,992,646 | * . . . . | * . . . . | * . . . . | * . . . . | 9.65 | . . | * . . . . |
| 1791 | 24,901,639 | 7,194,606 | . . . . | . . . . | . . . . | . . . . | 9.65 | . . | . . . . |
| 1800 | 113,339,751 | 4,092,677 | 1,000,000 | 90,909 | . . . . | . . . . | 12.64 | . . | . . . . |
| 1801 | 136,628,936 | 5,717,290 | 3,000,000 | 272,727 | . . . . | . . . . | 12.64 | . . | . . . . |
| 1810 | 55,104,722 | 8,055,629 | 16,000,000 | 1,333,333 | 8,000,000 | . . . . | 10.86 | 09.5 | . . . . |
| 1811 | 77,200,594 | 8,631,418 | 18,000,000 | 1,500,000 | 8,000,000 | . . . . | 10.86 | 10.7 | . . . . |
| 1820 | 66,730,129 | 9,835,140 | 27,000,000 | 2,250,000 | 25,500,000 | . . . . | 11.91 | . | . . . . |
| 1821 | 59,515,701 | 9,086,982 | 29,000,000 | 2,416,666 | 28,000,000 | . . . . | 11.91 | 06.1 | . . . . |
| 1830 | 86,490,113 | 8,374,139 | 84,315,000 | 6,485,769 | 69,000,000 | . . . . | 15.40 | 05.3 | 16,112,000 |
| 1831 | 109,231,168 | 17,085,878 | 86,625,000 | 6,663,461 | 70,000,000 | . . . . | 15.40 | 05.4 | 17,009,348 |
| 1840 | 120,941,277 | 19,703,620 | 132,825,000 | 10,217,307 | 89,000,000 | . . . . | 18.73 | 04.6 | 20,267,180 |
| 1841 | 184,264,995 | 19,355,028 | 101,442,000 | 7,803,230 | 76,000,000 | . . . . | 18.73 | 04.5 | 24,160,521 |
| 1850 | 218,439,055 | 25,044,835 | 294,532,524 | 21,038,037 | 269,769,000 | 12,000,000 | 30.18 | 03.4 | 26,835,930 |
| 1851 | 380,423,569 | 36,376,772 | 250,906,788 | 17,921,913 | 231,194,000 | 10,500,000 | 30.18 | 03.5 | 36,122,322 |
| 1856 | 545,262,754 | 23,617,674 | 269,843,882 | 19,274,563 | 254,569,000 | 15,274,140 | 29.17 | 04.3 | 51,237,034 |
| 1859 | 655,86[illegible],415 | 32,818,1[illegible]6 | † 427,962,150 | † 30,5[illegible]8,725 | ‡ 414,796,000 | ‡ 24,887,760 | 29.01 | 06.7 | 71,633,335 |
| 1860 | 694,879,795 | 30,922,633 | 262,048,500 | 18,717,750 | 255,115,750 | 17,858,100 | 28.16 | 07.2 | 57,118,800 |
| 1861 | 809,813,489 | 29,941,397 | 270,214,455 | 19,301,032 | 2[illegible]5,063,000 | 18,414,550 | 28.16 | 07. | 59,006,118 |
| 1868 | 1,121,221,670 | 56,408,435 | 43,068,168 | 3,076,297 | 41,400,000 | . . . . | 36.10 | 15. | 94,987,613 |
| 1869 | 1,247,885,371 | 53,304,430 | 99,803,786 | 7,128,841 | 95,051,225 | 5,636,920 | 37.15 | 10. | 104,321,817 |
| 1870 | 1,196,829,389 | 56,373,537 | 104,425,593 | 6,961,706 | 99,452,940 | 5,724,256 | 38.29 | 07.8 | 121,781,309 |
| 1871 | 1,277,525,009 | 44,401,359 | 177,322,521 | 11,821,501 | 168,878,592 | 10,281,419 | 38.20 | 07.2 | 118,169,271 |
| 1874 | 1,701,354,312 | 47,189,837 | 108,403,174 | 9,226,878 | 103,241,119 | 8,203,944 | 37.05 | 06.1 | 127,581,369 |
| 1875 | 1,797,586,806 | 49,112,255 | 141,229,925 | 12,415,328 | 134,504,691 | 11,516,828 | 38.14 | 05.9 | 124,783,647 |
| 1877 | 1,623,973,537 | 30,188,963 | 200,206,198 | 13,347,079 | 190,672,570 | 12,024,108 | 38.[illegible]8 | 06. | 130,286,154 |
| 1879 | 1,783,477,715 | 38,460,347 | 263,426,628 | 14,540,244 | 239,478,753 | 13,[illegible]18,404 | 38.92 | 05.4 | 136,107,318 |
| 1880 | 1,792,962,157 | 38,120,880 | 218,858,506 | 13,408,109 | 198,962,278 | 12,189,190 | 39.41 | 05.6 | 143,287,113 |

* No data for a report.

† The years of largest production were 1854, when the crop was 523,911,784 pounds, and 1862, when it was 551,843,292 pounds, and of molasses, in 1854, 37,422,270 gallons, and in 1862, 39,417,318 gallons.

‡ The production of sugar and molasses in Louisiana was greater in two years, 1854 and 1862, than in any of the years recorded in this table; in the former year it was, sugar, 495,156,000 pounds; molasses, 37,422,270 gallons; and in the latter, sugar, 528,321,500 pounds, and molasses, 39,372,369 gallons.

The preceding tables deserve careful study. They demonstrate several things. One of the deductions we make from them is that our people have a great appetite for sweets. Our consumption of cane sugar per head (to say nothing of the molasses), is 39.41 pounds, more than 12 ounces for each man, woman, and child per week. If we add to this the consumption of maple, sorghum, and cane sugar, and molasses, and syrups, it would make the whole amount about 20 ounces (1¼ pounds), per week per head. Other nations do not consume nearly as much per head, although in general the price is less. In France, the consumption, annually, is not more than 11 pounds per head; in Great Britain, about 30.5 pounds. Another deduction is that we can never do much toward supplying our home demand for sugar and molasses if we rely upon our own production of sugar from the sugar cane. In the year of largest production of cane sugar since the war—1879—our entire domestic production was only 263,426,628 pounds, while our imports the same year were 1,783,477,715 pounds, beside nearly 51 million pounds of molasses or syrup, so that our largest crop of cane sugar was only one-eighth of our consumption.

## II. Sugar from Other Sources.

Cane sugar is so uncertain a crop in our country, being propagated only by layers, never ripening here, and requiring a renewal of the cuttings from tropical climates every few years, that it cannot furnish anything like a certain supply, even if it were possible to increase its cultivation tenfold. During the past twelve years the ratio of production to importation has ranged from 1:27 to 1:65. It is obvious, therefore, that if we would not be dependent upon other nations for our sweetening to the extent of $100,000,000 or more, we must find some other plant, root, or fruit, which will yield us a supply sufficient for the vast demand. What shall it be? Sugar is produced in two ways: 1. By expression and evaporation from the sap or juices of plants. 2. By chemical action or changes, from starch, Indian corn, potatoes, etc. The first kind is a true sugar, and its sweetness comes from the amount of sucrose it contains; the second is what is known as grape sugar or glucose, contains only about three-fifths of the sweetening property of the true sugar, and while cheaper than the first, almost always contains acid or mineral impurities, and is generally prejudicial to health.

Sugar of the first kind has been made from the cane, from the stalks of the common Indian corn, from broom corn, from all the varieties of sorghum, from the Egyptian rice corn, the several varieties of millet, from the pumpkin, and the Hubbard and Boston Marrow squash; from the sap of the sugar maple, the sugar pine, the butternut, and some other trees, from the juice of the sugar and other beets, and the watery fluid of the watermelon.

The glucose, or grape sugar, has been made from potato starch, and from the starch of the horse-chestnut, acorn, etc., but the principal source of supply has been from Indian corn, which at the West is sold so low as to make this manufacture largely profitable. The farina, or starch of the corn, is treated with sulphuric acid till it is changed into glucose.

It is necessary for the profitable production of sugar on a large scale that the material from which it is produced should be constantly accessible, in ample and not variable supply, and at low cost, and it is desirable that it should contain pure sucrose, and a large percentage of it.

### 1. Maple Sugar.

The maple sap, and we presume the sap of some of the other trees mentioned, contains very pure sucrose, and an excellent sugar and syrup can be produced from it, but it is found only in limited districts of country, can only be procured for a brief season in the year, its production varies according to the season and weather, and there is not enough of it to exert any appreciable effect on the general supply. In 1860, nearly 39,000,000 pounds were made, and, it is said, in 1863, 1864, and 1865, a larger quantity, estimated as high as 60,000,000. In 1870, it had fallen off to 28,500,000 pounds; in 1876, it had reached its highest point, 43,288,080 pounds of sugar, and 2,100,000 gallons of molasses; since that time it has seriously declined. It will always command a fair price as a luxury, and, to some extent, for home use, but its production cannot materially increase, with our diminishing forests.

Of the other sugar-producing plants, roots, and fruits mentioned, several are not produced in sufficient quantity for manufacture on a large scale, and others would be found too expensive for use. Three of them, however, are more promising, viz., the sugar and other beets, the stalks of the Indian corn, and the sorghum of many varieties.

### 2. Beet Sugar.

That sugar can be made successfully from beet juice has been known in Europe for seventy years. The greater part of the sugar consumed in Germany, all of that in Holland and Belgium, and probably one-half of that in France, is made from the silesia or sugar beet. This manufacture is hedged round by such heavy tariffs, and encouraged by so many bounties for export, that its manufacture is profitable in those countries. In the United States, some beet sugar has been made of good quality, and, in several instances, extensive manufactories have been erected, and beets sown over an extensive area, but from a variety of causes the enterprises have not proved successful. In one instance, the ground was found to be too alkaline, and the beets so thoroughly charged with alkali that good sugar could not be made from them. In another, there was a difficulty in disposing of the refuse, or bagasse, to advantage, and in all, the operations proved too costly to compete successfully with cane sugar.

### 3. Sugar from the Canes or Stalks of Corn and Sorghum.

The production of molasses or syrup from cornstalks has been tried at various times since the revolutionary war, but generally with very rude apparatus, and imperfect purification, and it was used only because at the time and place nothing better could be obtained. Its production had nearly ceased, when, in 1856, the Chinese sorghum was extensively introduced throughout the country by Orange Judd, of the *American Agriculturist*, and the next year the African Imphee, another plant of the Sorghum family, was distributed by Leonard Wray, an English agriculturist. Both were recommended as sugar-producing plants, but the Imphee did not at first prove satisfactory, and has not been very largely cultivated. It was found in practice that though sugar could be produced from these sources, there was great difficulty in inducing granulation, and the juice must be boiled down at once, or it would sour and ferment. The greater part of the product of the sorghum was manufactured into molasses or syrup, much of it in a domestic way, and really an inferior article of unpleasant, weedy taste, and greenish color. When properly manufactured, however, this syrup or molasses was of good color, and in taste and quality superior to the best cane molasses or syrup. During the war, and immediately after, the molasses product was large, but there was very little sugar made. The largest yield of sugar and molasses was in 1866, when 511,565 pounds of sugar, and 21,500,000 gallons of molasses were made; 280,000 pounds of sugar, and 20,000,000 gallons of molasses were the highest amounts produced in any other year, and in 1877 the production had fallen off to 80,000 pounds of sugar, and 13,000,000 gallons of molasses. It had been supposed that the seed of the sorghum could not be ripened above 41° N. Lat., but in 1875 or 1876, a new variety, known as the Minnesota Early Amber Cane, had been found to ripen earlier, and to endure the climate of Minnesota.

### Mr. Stewart's Experiments with Corn and Sorghum.

In 1877, Mr. F. L. Stewart, of Marysville, Penn., who had been, since 1862, conducting a series of careful experiments for the production of sugar on an extended scale, published the conclusions to which his experiments had led him. He had experimented on the different varieties of Indian corn, as well as upon all the varieties of Sorgho and Imphee, and upon the sugar beet. We cannot here go into detail in regard to his processes, which were full of interest, but he had considered the whole subject of sugar production in its economic, as well as its other bearings, and was able to demonstrate that it was practicable to make from the corn and sorghum all the sugar which was needed in this vast and growing country, and an abundance for export; that our importation of sugar and molasses, now costing not less than 120 millions of dollars, could be replaced, and more than replaced, at about half the cost, by a crop grown by ourselves, and that this crop yielded as large, or nearly as large, a percentage of sugar of the purest and best quality as the cane, by processes much simpler and much less expensive, and with far less delay and greatly diminished outlay of capital. His discoveries related to the following points: The best time and mode of cutting the canes or stalks for sugar; the importance of immediate grinding or pressing the cane thoroughly, and boiling, concentrating, and granulating the sugar; the possibility of doing this with simple and inexpensive machinery, and by chemical processes, which the most ignorant could readily acquire; and the ability to utilize at a fair profit all secondary products. On all these points Mr. Stewart's published pamphlet was full and satisfactory. The crop to be realized in an average season he estimated as, for corn, 120 to 270 gallons of very dense syrup to the acre, or its equivalent of 1,500 to 3,000 pounds of sugar, and from 45 to 66 gallons of molasses; and of sorghum, from 100 to 350 gallons of dense syrup, or its equivalent of 1,200 to 4,200 pounds of sugar, and from 45 to 75 gallons of molasses. The yield of sugar and molasses from sorghum is about one-seventh more than from corn, and the sugar and molasses, if properly made, are somewhat whiter.

Mr. Stewart discovered that the corn and the sorghum both contained the greatest amount of sucrose, or crystallizable sugar, just as the corn and seed were about ripening; that the best variety of corn in Pennsylvania was Stowell's Evergreen, though some other of the larger and earlier varieties of sweet corn would answer nearly as well; of the varieties of sorghum the Chinese imphee contained the largest amount of crystallizable sugar (between 15 and 16 per cent.), and bore some delay in grinding better than any others, the Chinese regular sorghum coming next in these respects, while the red, black, and white imphee yielded smaller quantities of sugar.

The corn, Mr. Stewart says, should be cut when the silk of the upper ear has become dead, and the second ear is in the early "roasting-ear state," or, as they say at the West, in its full milk. Cut at this time, the ears can be utilized for making dried sweet corn, by cutting the corn from the cob by a machine in use for that purpose, and drying rapidly, either by sun or by an evaporator. This corn is worth $20 for a barrel of 300 pounds, and the sale of it more than makes up, he thinks, for the difference between the amount of sugar in the corn and that in the sorghum. The blades and tops can also be used for fodder, and where ensilage is desirable, both the ears, and the blades, and tops can be utilized for that purpose. The sorghum leaves, tops, and seed, can be used in the same way, or the dried seeds make excellent fattening food for cattle and swine. The *bagasse*, or residuum of the stalks, after pressing, may be used as litter, or for manures, or, when dried, furnish excellent fuel for the furnace which evaporates the juice into syrup, and the ashes of this material form an admirable fertilizer.

All the corn stalks, and most of the sorghum stalks, deteriorate very rapidly if suffered to lie after being cut, even for twenty-four hours. It is absolutely necessary, therefore, that they should be ground or pressed the same day they are cut, and that the pressure should be sufficiently strong to extract as nearly as possible the 85 per cent. of juice which is contained in them. The Chinese imphees, if the weather is not too hot, may bear storing for one or two weeks, but none of the others will. When the juice flows from the crushing mill it should be at once conducted (passing through wire gauze strainers in its way), to the heating tanks, which should be of a capacity of 100 gallons or more each, and which are of a variety of patterns and prices; from these it is conducted to broad and shallow evaporating pans, and thence to a finishing pan, from whence it goes to the cooler and the crystallizing vessels. Cream lime, or saccharate of lime, is used as a purifier in the first stage, the scum taken off, and the sediment drawn off from the bottom of the tanks; in the second stage, sulphurous acid is used to neutralize the lime. Evaporation in very shallow pans is recommended. No filtering through bone-black, or purifying by means of clay, is necessary. The product is a clean, light-colored sugar, equal to the very best cane sugars imported for sale as brown sugars, or for refining purposes. They contain little or no glucose, and are very pure. The gross value of the crop per acre at 4 cents per pound for the sugar, and 20 cents per gallon for the molasses, is from $70 to $135 per acre, besides the residuary matters, which will pay more than half the actual cost of the crop.

Subsequent experiments both on a small and a large scale, under the general direction of the late Commissioner of Agriculture, Gen. William G. Le Duc, who has taken a great interest in the development of this industry, have fully verified Mr. Stewart's observations. It seems to be well settled that on an average soil, fairly manured and well cultivated, such a soil as will yield 75 bushels of corn to the acre, a ton of sugar and 60 gallons of good molasses is the minimum crop, and good farmers expect from 1½ to 2 tons. At this rate it is the most profitable crop which can be grown, but the business should be conducted prudently, and without waste, as it can be very easily. The greatest trouble seems to be in the grinding, evaporating, and crystallizing the sugar; there is so much to be done in so short a time that some things are in danger of being neglected. This difficulty has been remedied in many of the Western towns in one of two ways: either the farmers have united and put up a grinding mill, heating tanks, evaporators, finishing pans, etc., of sufficient capacity to do all their work promptly, and hiring a manager, have taken their turns in making their sugar, or some individual has done the same thing, and charged a given rate per ton for making the sugar. Except on a large sugar-farm, one or other of these plans is better than the erection of a mill for each farm, and will produce better sugar. Very many farmers have rushed into the business during the past three years, and many more will attempt it the present year. Of course, some fail of success; some men are successful only in failing in whatever they undertake, and some have failed from causes beyond their control; but, on the whole, the prospect for the production of our own sugar on our own soil within the next five or ten years is very good, and a little farther on we may be able to export considerable quantities of refined sugar, if the cultivators of cane sugar do not glut the market.

### Glucose and Glucose Sugar.

This article would not be complete without some notice of the manufacture of glucose or inverted sugars and syrups, which is now carried on so extensively. As we have already stated, the bulk of these are made from corn, which is treated with dilute sulphuric acid, and the starch in the corn changed into glucose, or as it was formerly called, grape sugar. For a long time it was not supposed to be possible to crystallize glucose, and it was manufactured only in the form of syrup, which was used largely to dilute and adulterate sugar-house syrups, molasses, and honey. The glucose contains only about 50 to 60 per cent. as much sweetening power as cane or sorghum sugar. Of late it has been found possible to crystallize, or at least to granulate it, and it is used not only to adulterate true sugars, being considerably cheaper, but is sold as sugar, and in some forms is only detected by the purchasers from its lack of the sweetening property. It is also largely used in the manufacture of malt liquors, cheapening the production, but, it is believed, impairing its quality. It is used in the adulteration and doctoring of wines, adding to the sparkling character, and, it is said, also to the alcoholic strength. Many of our best physiologists believe that the frightful prevalence of Bright's disease of the kidneys, diabetes, and other kidney affections, is largely induced by the excessive consumption of glucose in one or other of these forms. The manufacture of this and other articles used for the adulteration of articles of food and beverage is a fraud on the community, and should be prohibited or checked by law. There may be legitimate uses for glucose; if so, let it be confined to those uses; but when it is applied to the adulteration of articles of food or drink such use should be punished with fine and imprisonment.

# COMMERCE OF THE UNITED STATES.

## CHAPTER I.

### COLONIAL TRADE—IMPERIAL RESTRICTIONS —EMANCIPATION OF INHABITANTS.

THE history of the commerce and trade of a people is a record of their industry and productive powers, since all trade is but an interchange of the products of labor, and wealth but an accumulation of those products beyond the necessary annual consumption, and wear and tear from use. In the United States, since the date of their settlement, the development of trade and the accumulation of property have been more rapid than in any other country. This has been the case, chiefly, for five leading reasons: 1. The ample supply of fertile land free to the cultivator. 2. The persevering and intelligent industry of the people, combined with an inventive genius that has constantly smoothed the way of labor by devising the means of producing greater results with the same manual force. 3. The rapid increase of population, both from the great excess of births over deaths, owing to the excellent climate and general morality of the people, and from an unprecedented immigration (over ten millions,) of the best classes of Europeans to this country, to enjoy the benefit of our free institutions. This influx from Europe is greater now than ever before. 4. The accumulation of capital applicable to reproductive industries, as well through the frugal habits of the people, who have consumed far less than they have produced, as by the influx of capital from abroad, not only in the hands of immigrants, but for investments, that will yield larger revenue to European holders than they can there obtain. And, 5th, and perhaps more important than all, was the control that the people have kept of their own funds. They have had no absolute rulers or dynasties to involve them in devastating wars. Until the civil war (1861–65) very little had been wasted in military expenses. And when the nation emerged, after a four years' struggle, from its great war, with a debt amounting in August, 1865, to $2,845,907,-626, so great were its remaining resources, and so strong its vitality that its own citizens carried the greater part of the debt, and in 16 years had reduced it by more than a third, and its credit was so good that it could refund the whole in six months time, at 3½ per cent.

The following table shows the general condition of the country in 1700, eighty years after its first settlement; in 1790, at its birth as a nation; in 1860, just before its great war, and in 1880, fifteen years after the termination of that war:

| Years. | Population. | Annual Agricultural Products. | Manufactures. | Valuation of Real and Personal Property. |
|---|---|---|---|---|
| 1700 | 262,000 | ............. | ............. | ............. |
| 1790 | 3,929,214 | $150,000,000 | ............. | $479,293,263 |
| 1860 | 31,443,321 | 2,000,000,000 | $1,886,000,000 | 16,159,616,008 |
| 1880 | 50,152,866 | 2,763,103,800 | 8,232,160,312 | 58,060,725,903 |

In the 170 years preceding 1790, the population had only increased to 3,929,872, including the negroes; and the taxable valuation to $479,293,263, including the land. In the next 70 years the population increased eight-fold, and the taxable property forty-fold. Of the population the whole increase was 27,514,107. Of these, 4,138,691 were immigrants of foreign birth and 4,441,-830 were colored, leaving 18,933,586 whites of native birth. About 15 per cent. of the increase of the 70 years was from immigration. The increase in agricultural products was eight-fold and of manufactures probably 600 fold, for the British Government had prohibited colonial manufactures. The increase in taxable property was enormous.

The advance of the next twenty years (of which four were years of desolating and destructive war) was still more remarkable. In these twenty years the population had increased 59.5 per cent. or 18,709,545, the agricultural productions 38.5 per cent. The manufactures had increased 450 per cent. and the valuation 360 per cent. As this valuation is for purposes of taxation it represented only about 60 per cent. of the real value of property, and the vast amount of property, real and personal, owned by the U. S. Government is never estimated.

The early settlers in all the colonies had to depend mostly upon agricultural products, first for their own maintenance, and then as a means of procuring, by a sale of the surplus, those manufactured articles which, under the rigorous rule of the mother country, they were not allowed to produce themselves. The early policy of the imperial government was to make the colonies a source of profit to the mother country, and this was sought by restraining the colonists from any pursuit that came in conflict with the industry of the mother country, and to confine them to the production of such articles as she stood most in need of. Those articles they were allowed to sell only to the mother country, and were to buy what they stood in need of only of her. Under those general restrictions the colonists, with little capital, and a barren soil at the north, were to prosper as they could. Their genius and restless energy, however, stood them in stead. But they were compelled to encounter new restrictions at every turn. The provinces were in some cases grants to individuals, and in others to companies. This involved, of course, their own government. But soon the Crown claimed the right of confirming the governor. They were forbidden to coin money, to sell lands to any but British subjects, to cut down pine-trees on any pretence, to send wool to any place out of the king's dominions, to export any produce except in English vessels, of which the master and three-fourths of the crew were English. Thus every new progress of the colonies, even in settling and working the land, was followed by a new restraint. But when they began to manufacture, new anxieties seized the home government. Early in the eighteenth century an act of parliament forbade the manufacture of hats; and Massachusetts Bay gave offence by undertaking the manufacture of paper. New York incurred displeasure by taxing slaves imported from Africa, five ounces of silver each; and the ire of the government was further aroused by the rebellious disposition that prompted the New England people to work up their own wool and flax into home-spun goods. They also attempted to start banks, which parliament prohibited; and they forbade the manufacture of iron beyond the state of pig, and interdicted foreign-built vessels from the colonial trade. In spite of all these continually multiplying vexations, the colonists contrived to find something to do, and the fact that they did so kept the home government continually upon the "anxious seat." A parliamentary committee was finally appointed to look into the manner in which those colonists employed their time, and the committee of parliament reported as follows:—

"The governor of Massachusetts Bay informed us that in some parts of this province the inhabitants worked up their wool and flax into an ordinary coarse cloth for their own use, but did not export any. That the greatest part of the woollen and linen clothing worn in this province was imported from Great Britain, and sometimes from Ireland; but, considering the excessive price of labor in New England, the merchants could afford what was imported cheaper than what was made in that country. That there were also a few hat-makers in the maritime towns; and that the greater part of the leather used in that country was manufactured among themselves. That there had been for many years some iron works in that province, which had afforded the people iron for some of their necessary occasions; but that the iron imported from Great Britain was esteemed much the best, and wholly used by the shipping. And that the iron works of that province were not able to supply the twentieth part of what was necessary for the use of the country. They had no manufactures in the province of New York that deserved mentioning; their trade consisted chiefly in furs, whalebone, oil, pitch, tar, and provisions. No manufactures in New Jersey that deserve mentioning, their trade being chiefly in provisions shipped from New York and Pennsylvania. The chief trade of Pennsylvania lay in the exportation of provisions and lumber, no manufactures being established, and their clothing and utensils for their houses being all imported from Great Britain. By further advices from New Hampshire, the woollen manufacture appears to have decreased, the common lands, on which the sheep used to feed, being now appropriated, and the people almost wholly clothed with woollen from Great Britain.

The manufacture of flax into linen, some coarser, some finer, daily increased by the great resort of people from Ireland thither, who are well skilled in that business; and the chief trade of this province continued, as for many years past, in the exportation of naval stores, lumber, and fish. By later accounts from Massachusetts Bay, in New England, the assembly have voted a bounty of 30s. for every piece of duck or canvas made in the province. Some other manufactures are carried on there, as brown Hollands for women's wear, which lessens the importation of calicos, and some other sorts of East India goods. They also make some small quantities of cloth made of linen and cotton, for ordinary shirting and sheeting. By a paper-mill set up three years ago, they make to the value of £200 sterling yearly. There are also several forges for making bar-iron, and some furnaces for cast-iron or hollow ware, and one sitting-mill, and a manufactory of nails. The governor writes concerning the woollen manufacture, that the country people, who used formerly to make most of their clothing out of their own wool, do not now make a third part of what they wear, but are mostly clothed with British manufactures. The same governor (Belcher), by some of his letters of an older date, in answer to our annual queries, writes, that there are some few copper mines in this province, but so far distant from water-carriage, and the ore so poor, that it is not worth the digging. The surveyor-general of his Majesty's woods writes, that they have in New England six furnaces and nineteen forges for making iron, and that in this province many ships are built for the French and Spaniards in return for rum, molasses, wines, and silks, which they truck there by connivance. Great quantities of hats are made in New England, of which the company of hatters of London have likewise lately complained to us, that great quantities of those hats are exported to Spain, Portugal, and our West India islands. They also make all sorts of iron work for shipping. There are several still-houses and sugar-bakers established in New England. By later advices from New York, there are no manufactures there that can affect those of Great Britain. There is yearly imported into New York a very large quantity of the woollen manufactures of this kingdom for their clothing, which they would be rendered incapable to pay for, and would be reduced to the necessity of making for themselves, if they were prohibited from receiving from the foreign sugar colonies the money, rum, sugar, molasses, cocoa, indigo, cotton, wool, etc., which they at present take in return for provisions, horses, and lumber, the produce of that province and of New Jersey, of which he affirms, the British sugar colonies do not take off above one-half. But the company of hatters of London have since informed us, that hats are manufactured in great quantities in this province. By the last letters from the deputy-governor of Pennsylvania, he does not know of any trade carried on in that province that can be injurious to this kingdom. They do not export any woollen or linen manufactures, all that they make, which are of a coarser sort, being for their own use. We are further informed that in this province are built many brigantines and small sloops, which they sell to the West Indies. The governor of Rhode Island informs us, in answer to our queries, that there are iron mines there, but not a fourth part iron enough to serve their own use; but he takes no notice of any sort of manufacture set up there. No return from the governor of Connecticut; but we find, by some accounts, that the produce of this colony is timber, boards, all sorts of English grain, hemp, flax, sheep, black cattle, swine, horses, goats, and tobacco; that they export horses and lumber to the West Indies, and receive in return sugar, salt, molasses, and rum. We likewise find that their manufactures are very inconsiderable, the people there being generally employed in tillage, some few in tanning, shoemaking, and other handicrafts; others in the building, and joiners', tailors', and smiths' work, without which they could not subsist."

The old northern colonies in America had, it is well known, very few articles fit for the British market, and yet they every year took off large quantities of merchandise from Great Britain, for which they made payments with tolerable regularity. Although they could not, like the Spanish colonists, dig the money out of their own soil, yet they found means to make a great part of their remittances in gold and silver dug out of the Spanish mines. This they effected by being general carriers, and by a circuitous commerce carried on in small vessels, chiefly with the foreign West India settlements, to which they carried lumber of all sorts, fish of an inferior quality, beef, pork, butter, horses, poultry and other live stock, an inferior kind of tobacco, corn, flour, bread, cider, and even apples, cabbages, onions, etc., and also vessels built at a small expense, the materials being almost all within themselves; for which they received in return silver and gold, some of which remained as current coin among themselves, but the greatest part was remitted home to Britain, and, together with bills of exchange, generally remitted to London, for the proceeds of their best fish, sold in the Roman Catholic countries of Europe, served to pay for the goods they received from the mother country. This trade united all the advantages which the wisest and most philanthropic philosopher, or the most enlightened legislator, could wish to derive from commerce. It gave bread to the industrious in North America by carrying off their lumber, which must otherwise rot on their hands, and their fish, great part of which without it would be absolutely unsaleable, together with their spare produce, and stock of every kind. It furnished the West India planters with those articles without which the operations of their plantations must be at a stand, and it produced a fund for employing a great number of industrious manufacturers in Great Britain: thus taking off the superfluities, providing for the necessities, and promoting the happiness of all concerned. This trade, however, was almost entirely ruined by the rigorous execution of the orders against smuggling and the collection of the duties in hard silver, which soon drained the country of any little real money circulating in it. And, as if government had intended to prevent the colonists from having even the shadow of money, another act was passed in a few days after that for the new duties, declaring that no paper bills to be henceforth issued should be made a legal tender in payment, and enjoining those in circulation to be sunk (that is, paid off in hard money) at the limited time. That vast quantities of goods were imported, in direct violation of the letter and spirit of the law and of the commercial system of the mother country, there is no doubt. But it could not well be otherwise in a country so remote from the government to which it professed allegiance, and possessing an extent of coast which no chain of revenue cruisers that could be supported by government would be sufficient to guard with any kind of effect. The soil of the New England provinces scarcely furnished provisions sufficient to support the inhabitants. Their industry had therefore been chiefly directed to the sea—to fishing, navigation, and the various branches of business subservient to them. The cod, salmon, mackerel, sturgeon, and other species of fish which frequented the coasts and rivers in prodigious shoals, afforded employment to great numbers in taking, curing, and packing them. The New Englanders also frequented the banks and coasts of Newfoundland, and the fishing grounds in the Gulf of St. Lawrence as far as the coasts of Labrador. Besides their own fishing, they procured from the Newfoundland fishermen a part of the fish taken by them in exchange for rum of their own manufacture, and other articles of American and West India produce. The following record of rum exported from the colonies now forming the United States (chiefly from New England) to the provinces of Nova Scotia, Quebec, and Newfoundland, affords a specimen of the extent of that trade during a few years preceding the revolution:—

| | | 1770. | 1771. | 1772. | 1773. |
|---|---|---|---|---|---|
| West India rum, | gallons | 52,712 | 36,873 | 47,736 | 50,716 |
| American rum, | " | 590,748 | 550,514 | 520,525 | 608,025 |
| | | 643,460 | 587,387 | 568,261 | 658,741 |

The fish, after being sorted in the harbors, were shipped off to the countries for which each quality was best adapted. The best were carried to the southern parts of Europe, and the proceeds were generally remitted to Great Britain in bills of exchange to pay for the goods they had occasion for. A small quantity of the best fish was also sent to Britain, and the inferior sorts were destined to give a relish to the plantains and yams which constituted the principal part of the food of the negro slaves in the West Indies. After the peace of 1763, the whale fishery increased in the seas between the New England coasts and Labrador, in consequence of the encouragement given to it by the great reduction of the duties on the oil and whale fins, so much, that instead of eighty or ninety sloops, which had gone upon the whale fishery, they employed 160 in that business before the year 1775, and the other branches of their fishery increased in the same proportion. In addition to the commerce supported by the produce of their fisheries, they drove a very profitable circuitous carrying trade, which greatly enriched them, and supplied most of the money in circulation. Besides building vessels for the service of their own commerce, they built great numbers, but of no very good quality of wood or workmanship, for sale; and from the molasses, which they brought in great quantities from the West Indies (chiefly from the French islands), they distilled rum, which, though much inferior to that of the West Indies, was very acceptable to the Indians, who readily received it in exchange for their furs and peltry. They also found a great sale for it among the fishermen; considerable quantities of it were shipped to Africa, and exchanged for slaves, or sold to the resident European slave merchants for gold dust, ivory, woods, wax, and gums. The candles made of spermaceti, furnished by the whale fishery, formed also an article of export to the amount of three or four hundred thousand pounds weight in a year, besides what were consumed upon the continent. Their exports to Great Britain consisted chiefly of fish-oil, whalebone (or fins), masts and other spars, to which were added several raw materials for manufactures collected in their circuitous trading voyages, and a balance paid in foreign gold and silver coins. In short, their earnest application to fisheries and the carrying trade, together with their unremitting attention to the most minute article which could be made to yield a profit, obtained them the appellation of the Dutchmen of America. New York, New Jersey, Pennsylvania, and Delaware have a much better soil than that of the New England provinces, and they then, as now, produced corn and cattle of all kinds in great abundance, and also hemp, flax, and lumber; to which may be added iron, potashes, and pearl-ashes. Their exports were corn of all kinds, flour and bread in great quantities, salted provisions of all sorts, live stock, including horses, horned cattle, hogs and sheep, and all kinds of poultry in great numbers, flax and hemp, boards, scantling, staves, shingles, and wooden houses framed and ready to fit up, iron in pigs and bars, and vessels, superior in workmanship to those of New England. Their chief markets for these commodities were the British and foreign West Indies, Spain, Portugal, the Western islands, Madeira and the Canary islands, whence they carried home the produce of each country and bullion. Great Britain and Ireland received from them iron, hemp, flax, feed, some lumber, and skins and furs, the produce of their trade with the Indians, together with some articles of their imports from other provinces and from foreign countries, which were raw materials for British manufactures and bullion. Maryland and Virginia almost from their first settlement made tobacco the principal object of their culture, and it long continued to constitute the most valuable export of British America; but the quantity of tobacco was diminishing in these provinces for many years before the revolution, owing to the soil being exhausted by it, and the planters had turned much of their tobacco land to the cultivation of wheat and other grain. Their tobacco could by law be exported only to Great Britain; but their corn, flour, lumber, etc., were carried to the West Indies and elsewhere. North Carolina produced also some tobacco, and it furnished pitch, tar, and turpentine, of which about 130,000 barrels were annually exported, whereof the greatest part came to Britain. The following accounts, copied from those of the custom-house, for the year nearly preceding the revolution, show the exports of the then colonies of America:—

AN ACCOUNT OF THE VALUE, IN STERLING MONEY, OF THE EXPORTS OF THE SEVERAL PROVINCES UNDERMENTIONED, IN THE YEAR 1770.

| | To Great Britain. | | | To South of Europe. | | | To West Indies. | | | To Africa. | | | Total. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £. | s. | d. | £. | s. | d. | £. | s. | d. | £. | s. | d. | £. | s. | d. |
| New Hampshire } Massachusetts } Rhode Island } Connecticut } | 142,775 | 12 | 9 | 464 | 0 | 5 | 40,431 | 8 | 4 | 96 | 11 | 3 | 550,089 | 19 | 2 |
| | | | | 76,702 | 0 | 4 | 123,394 | 0 | 6 | 9,801 | 9 | 10 | | | |
| | | | | 1,440 | 11 | 0 | 65,206 | 13 | 2 | 7,814 | 19 | 8 | | | |
| | | | | 2,567 | 4 | 5 | 79,395 | 7 | 6 | | | | | | |
| New York....... | 113,382 | 8 | 8 | 50,885 | 13 | 0 | 66.324 | 17 | 5 | 1,313 | 2 | 6 | 231,906 | 1 | 7 |
| New Jersey...... | | | | | | | 2,531 | 16 | 5 | | | | 2,531 | 16 | 5 |
| Pennsylvania..... | 28,112 | 6 | 9 | 203,952 | 11 | 11 | 178,331 | 7 | 8 | 560 | 9 | 9 | 410,756 | 16 | 1 |
| Maryland } Virginia } ...... | 759,961 | 5 | 0 | 66,555 | 11 | 11 | 22,303 | 9 | 2 | | | | 991,401 | 18 | 6 |
| | | | | 73,635 | 3 | 4 | 68,946 | 9 | 1 | | | | | | |
| North Carolina } South Carolina } | 405,014 | 13 | 1 | 3,238 | 3 | 7 | 27,944 | 7 | 9 | 71 | 15 | 4 | 569,584 | 17 | 3 |
| | | | | 72,881 | 9 | 3 | 59,814 | 11 | 6 | 619 | 10 | 9 | | | |
| Georgia ........ | 82,270 | 2 | 3 | 614 | 2 | 0 | 13,285 | 15 | 1 | | | | 96,169 | 19 | 4 |
| Total..... | £1,531,516 | 8 | 6 | £552,937 | 11 | 2 | £747,910 | 3 | 7 | £20,277 | 19 | 1 | £2,852,441 | 8 | 4 |

The exports of North Carolina to the West Indies consisted mostly of salt pork, Indian corn, peas, etc. But its foreign trade was very trifling in proportion to its great extent, and even to the quantity of its productions, and was mostly in the hands of the merchants of the adjacent provinces of Virginia and South Carolina, and of the New Englanders. In South Carolina and Georgia rice and indigo were the staple articles. The former grows on the marshy grounds near the coast, and the latter on the dry soil of the inland country. The planters had for some time applied themselves to the culture of tobacco; it was not until later that the cultivation of cotton was introduced. They made then considerable quantities of lumber. Their exports consisted of these articles; and the merchants of Charleston also shipped some skins obtained by trade with the neighboring Indians, and part of the produce of North Carolina.

The chief dependence of the colonies for the means of turning their industry to account, was thus apparently the West India trade. Every interest in England had been protected at the expense of the colonies, and the united restrictions had resulted in a larger West India trade. The government now came in to protect itself, and, to raise a revenue, laid a heavy tax upon the West India trade in 1764.

The burdens of the colonists were getting rather too many and heavy, and the people more and more disposed to question the utility of a connection which was enforced avowedly that the colonists might be hewers of wood and drawers of water for the service of the mother country. The first movement in view of the fact that the cutting off of their trade would prevent them from buying of the mother country, was to enter into an association to abstain from British goods, and to manufacture for themselves. Then commenced an active struggle. Surveyors-general were sent to America, stamp duties levied, and all the stamped paper sent out from England was burnt up by the colonists as soon as it arrived. The merchants entered into an agreement to import no more goods from Great Britain, and a manufacturing society was established. Woollen factoring became the rage, and so far was it carried, that resolutions were passed not to eat lamb, and not to patronise any butcher who killed lambs. They resolved to send no more tobacco to England. These resolutions caused a great revulsion in England among those who could get no remittance and those who had made goods for the American market. The government felt the force of this pressure, and the stamp act was repealed; but, at the same time, the moral effect of the repeal was destroyed by the declaration that the acts of parliament bound the colonies. Then followed more duties, more regulations, more resistance, increasing anger on both sides, until, in the year 1775, parliament prohibited all trade with America, and the united colonies opened their ports to all nations. During the war which ensued, the business of the country of course suffered; but a very extensive illegal trade was carried on by some of the high officers of the English government, who, under licenses granted to carry stores and provisions for the army, cleared vessels for Boston, Halifax, or Quebec, *with liberty to go to any other port*, and sent cargoes of general merchandise for sale at great profits.

These events closed colonial trade. The high profits to be derived from the sale of goods and produce during the war were too tempting to permit trade altogether to cease, notwithstanding the acts of Congress. Lord Sheffield states that one ship in particular cleared from London for New York, but went directly to Boston, where her cargo sold at 270 per cent. profit. Many cargoes were paid for in cash before they left England, on account of the risk. The cities in the United States in the power of the British were crowded with the faithful; at the same time the surrounding back country did not sympathise with them, and, as a consequence, provisions were very scarce and high. This gave rise to a clandestine trade, by which a vessel would be loaded with produce and sent to a particular spot, where, through connivance, she would be "captured," and her cargo sold as a prize, at very high prices, to the profit of both captors and owners. American produce also found its way to Europe.

With the year 1783 came peace, and with it a new era opened in the world's commerce. Britain had always treated the colonies as having no rights, and she was now required to treat with them as equals, not only in a political and commercial sense, but as rivals on the ocean, which she had hitherto affected to rule. The United States were then in by no means a prosperous condition. Their commerce had been ruined by the war; the few manufactures which had been forced into being during the difficulties had to encounter ruinous competition from imports with the return of peace; the country was flooded with depreciated paper money, of which over

$360,000,000 had been issued. The states were in debt $20,000,000, and the federal government $42,000,375; specie had mostly disappeared from circulation, and the country was without a mint, or a regular system of finance. Private credit was greatly impaired. The collection of debts had been suspended during the war, and with the return of peace the courts were filled with suits; while the markets were flooded with goods beyond the power of purchase. The several states exercised the power of issuing paper money, and making it a legal tender for debts, and each exercised the right of imposing duties upon imports and exports. All these evils were producing the most disastrous results, and in Massachusetts an open insurrection, known as Shays's rebellion, threatened not only the peace of that state, but the existence of the Union, which, indeed, was very feeble under the confederation. In September, 1787, the present constitution was finally adopted, and the work of construction commenced. The leading measures adopted did not come fully into operation until 1791, when the custom-houses, the mint, the bank, the post-office, commercial treaties, and duties on imports, with the restrictions upon the states as to levying duties, coining money, making paper a legal tender, and minor regulations, were put in force.

The power granted to Congress by the new constitution, of levying duties upon goods imported into the country, met the exigencies of the case. The states had been repeatedly and vigorously called upon to provide the means of meeting the public debt and expenses, and it was urged upon them that independent means granted to it was the only way by which the federal government could sustain its position. This power, with that to levy direct taxes, was finally obtained by Congress under the constitution of 1787. In the meantime the exports of the country were actively resumed with the cessation of hostilities. There were, however, no means of knowing the actual state of trade until the adoption of the regulations under the constitution of 1791. The trade was, however, very active. The desire to trade on both sides was great; and no sooner was peace declared, than the king by proclamation removed all legal restraints upon intercourse with the United States, dispensing for a limited time with a manifest, certificate, or other legal document on the arrival of any vessel belonging to the United States in Great Britain. American vessels generally were placed upon the footing of colonial vessels. Although there were no United States official returns, the English custom-house returns show the trade between the two countries for that period as follows:—

| | Exports to Great Britain. | Imports from Great Britain. |
|---|---|---|
| 1784, | £743,345 | £3,670,467 |
| 1785, | 893,594 | 2,308,023 |
| 1786, | 843,119 | 1,603,465 |
| 1787, | 893,637 | 2,009,111 |
| 1788, | 1,023,789 | 1,886,142 |
| 1789, | 1,050,198 | 2,525,298 |
| 1790, | 1,191,071 | 3,431,778 |

The imports from Great Britain alone, in the two first years of peace, must have been nearly $30,000,000, or $10 per head of the people against an export of $9,000,000, and were sufficient cause for much distress. This was, however, of a nature which would naturally cure itself, since it involved a fall in prices that would promote exports and check imports, and these were more nearly equalized in 1788.

In that year, however, a new event gave a great impulse to American exports. The French government had previously made a free trade treaty with England; and in 1787, under the liberal sentiments which that government espoused, they issued a decree, placing American citizens commercially on the same footing as Frenchmen, and admitting American produce free of duty. Under this regulation, the United States exported in 1788, 246,480 tierces of rice, 140,959 barrels of flour, 3,664,176 bushels of wheat, 558,891 bushels of rye, 520,262 bushels of barley. These figures represent very large exports for the state of the country at that time, when the population was small, and the farm produce drawn altogether from the Atlantic states of the country. The farms of the Hudson river and its milling powers were then in great requisition. The fisheries had large sales, and the south exported freely its rice. The enjoyment of the French and English trade gave a great impulse to the shipping interest, and the United States were rapidly growing into a power whose influence was felt in all the commercial relations of England. The political difficulties of Europe were also taking a new shape. The failure of the harvests hastened the march of affairs, and a new war between France and England left in the hands of the United States the carrying trade of the world. While American shipping was called upon to supply raw materials and food for England and western Europe, it was also called upon to carry between European countries and their colonies. French ships could no longer safely trade with the West Indies, the Spanish merchants and government depended upon neutral flags to convey their merchandise and treasures, and even the English preferred the safety of third bottoms for the transport of their goods. The insurrection in St. Domingo, and the events in other islands, drove great numbers of persons to the United States, and many fortunes were founded. That of Stephen Girard received a great accession from the wealth placed on board his ships by persons who were slaughtered in the attempt to follow. The activity with which American shipping was employed in those years did not prevent them from seeking new trade in the east, and an American ship made its appearance in the China seas, in a commerce which has not ceased to grow to the present day. The period was marked by the development of the most enterprising genius in mercantile adventure. The fame of William Gray, of Boston, soon became world-wide, and was as honored in the east as it was in the west. His ships navigated every sea, and employed hundreds of hardy men. The skilful and bold seamen who commanded his ships were not of the later class of "dandy captains," who came in with the "liners," but it was his saying that the best captains would sail with a load of fish to the West Indies, hang up a stocking in the cabin and put therein the hard dollars as they sold the fish, and pay out from it as they bought the rum, or molasses, or sugar, tie up the balance, and hand it into the counting-house on their arrival home, in lieu of all accounts. The honesty and judgment of their proceedings were beyond question; and the problem of profits between the fish sent and the cargo and stocking returned, was for the clerks to solve. The genius for plotting long and intricate voyages belonged to the head of the house. New York, in John Jacob Astor, had still a more extensive operator. He first projected the enterprises to the north-west coast, and laid out schemes which required ten years to ripen, with profound skill, and his name was known throughout the world. Philadelphia had an exponent of her commercial power in Stephen Girard, whose enterprises belonged to the same period of large operations and bold conduct. The Patersons of Baltimore led the commerce of that city; and behind these leading names came a crowd of great merchants—for the mercantile intellect seemed as active in that day as was military, political, and literary genius both on this continent and throughout the world.

With the year 1791 the new government of the United States, under the constitution adopted 1787, came into operation, and from that date regular official figures of the annual progress of the national commerce have been published. The leading changes produced by that event were the abolishment of all state laws imposing duties upon imports and exports; the creation of a tariff by Congress; the establishment of a mint, a national bank, a post-office; the funding of the government circulating paper, the withdrawal of all state issues, and the enactment of a navigation law in retaliation of the English law. The general course of trade proceeded, however, much as before, until it encountered the interruption that grew out of the European war. A few years of this prosperity excited the ire of the belligerents, and England could no longer refrain from treating the Americans still as colonists. In 1793 she issued an order to prevent food from being carried to any port occupied by French troops, and also to prevent American vessels from trading between France and her colonies. She also exercised the right of impressing American seamen to man her navy. Under these and other orders, American merchants had been robbed of large amounts of property. The complaints thus created threatened war; but it was arrested by a treaty concluded by Mr. Jay, under which $10,000,000 indemnity was paid. This treaty gave umbrage to France, which also seized American vessels; but the first consul put an end to the complaints in 1800. England had, however, in view of the apparently progressive difficulties in Europe, revived the principle she had laid down in 1756, viz.: that neutrals could carry on no trade in time of war that they had not pursued in time of peace: in other words, that American ships should not do the French carrying trade. Her next step, in May, 1806, was to promulgate the unheard-of and absurd edict, that Europe was in a state of blockade from the Elbe to Brest. The import of this was, that American ships should visit none of those ports. This monstrous pretension, in addition to some minor orders, drew from Napoleon, November, 1806, his Berlin decree in retaliation, prohibiting all intercourse with the British islands. This was replied to, by Great Britain declaring France and her colonies in a state of blockade. To these insane edicts on both sides succeeded others, which so multiplied the difficulties of commerce that the United States government, to avoid war, laid an embargo upon commerce in 1808. It was not to be expected, however, that when the chief interests of the country were commercial, that such a measure should be otherwise than very unpopular, and the government changed it, in 1809, to non-intercourse with France and Great Britain. Notwithstanding all the troubles thrown in the way of commerce by the edicts of France and England, the American merchants contrived to carry on a large traffic. Under Bonaparte's continental system, which sought to exclude colonial and British productions, produce was very scarce and high in Europe. The emperor, to remedy the matter, offered high premiums for the invention of substitutes for many articles, such as indigo, cane sugar, coffee, etc. To those premiums are due the large use now made of chicory-root as a substitute for coffee. It originated in Germany, but has since spread to England and the United States. Beet-root sugar, which has become so large an industry in France and Germany, being equal in consumption to cane, originated in the same manner. Nevertheless, all commodities were very high, and when a cargo could be got in, it realized a fortune. To get them in was the problem; and this was usually done by fees, or *pots de vin*, which were mostly appropriated by Talleyrand and Fouché, and afterward rights were openly sold by the emperor to raise money. Jerome Bonaparte, who died so recently, had married, in 1803, Miss Paterson, of Baltimore, a direct descendant of "Old Mortality," immortalized by Scott in a novel. The Paterson interest with Jerome was the means of procuring admission for many a valuable cargo. Interest and enterprise effected much, and few merchants desired to lose all chance through the intervention of their own government. Nevertheless, the embargo took place in 1808. The progress of trade from 1790 to 1808, was as follows:—

IMPORTS AND EXPORTS OF THE UNITED STATES, AND TONNAGE IN THE FOREIGN TRADE.

| | Tonnage. | Dom. exports. | For. exports. | Total exports. | Imports. |
|---|---|---|---|---|---|
| 1790, | 474,374 | $19,666.000 | $539,156 | $20,205,156 | $23,000,000 |
| 1791, | 502,146 | 18,500,000 | 512,041 | 19 012 041 | 29,200,000 |
| 1792, | 564,457 | 19,000,000 | 1,753,098 | 20,753,098 | 31,500,000 |
| 1793, | 520,764 | 24,000,000 | 2,109,572 | 26,109,572 | 31,100,000 |
| 1794, | 628,618 | 26,500,000 | 6,526,233 | 33,026,233 | 34,600,000 |
| 1795, | 747,965 | 39 500,000 | 8,489,472 | 47,989,472 | 69,756,268 |
| 1796, | 831,899 | 40,764,097 | 26,300,000 | 67,064 097 | 81,436,164 |
| 1797, | 876,913 | 29,850,026 | 27,000,000 | 56,850,206 | 75,379,406 |
| 1798, | 898,328 | 28,527,097 | 33,000,000 | 61,527,097 | 68,551,700 |
| 1799, | 939,400 | 33,142.522 | 45,523,000 | 78,665,522 | 79,069,148 |
| 1800, | 972,492 | 31,840,903 | 39,130,877 | 70,971,780 | 91,252,768 |
| 1801, | 947,577 | 47,473,204 | 46,642,721 | 94,115,925 | 111,363,511 |
| 1802, | 892,104 | 36,708,189 | 35,774,971 | 72,483,160 | 76,333,333 |
| 1803, | 949,172 | 42,205,961 | 13,594,072 | 55.800.033 | 64,666,666 |
| 1804, | 1,042,404 | 41,467,477 | 36,231,597 | 77,699,074 | 85,000,000 |
| 1805, | 1,140,368 | 42,387,002 | 53,179,019 | 95,566,021 | 120,600,000 |
| 1806, | 1,208,716 | 41,253,727 | 60,283,236 | 101,536,963 | 129,410,000 |
| 1807. | 1,268,548 | 48,699,592 | 59,643,558 | 108,343,150 | 138,500,000 |

In the period here embraced there occurred many events which had a very lasting and important bearing upon the future of the United States. The temporary free trade with France had imparted a sudden impulse to the export of farm produce. The wars that succeeded greatly enlarged the sphere of action for the shipping, and we find in the table that the imports of goods rose year by year from 23,000,000 in 1790 to 138,000,000 in 1807. Of these large imports, however, it appears, from the column of exports of foreign merchandise, a large portion was re-exported, forming the carrying trade between the countries of Europe and their colonies, that the war threw into the American bottoms, and which passed through American ports. A large portion of this trade was paid in money in England, forming those credits which were transferred by the Americans to the English, in payment of merchandise thence imported. Thus the trade was generally in favor of England with the United States, and in favor of the latter with Europe. Now, as England could have no direct trade with Europe during the war, and yet was compelled to send funds thither for political purposes, the credits she received from the Americans were of vast service to her. It was in the conduct of that trade that the tonnage multiplied to the extent seen in the column. The amount increased from 474,374 tons in 1790, to over 1,260,000 tons in 1807, or an increase in capital so employed from $15,-000,000 to $50,000,000 The wealth of the country was thus rapidly increasing in a foreign trade, which formed one-half of the whole commerce. The fisheries were very active and flourishing; the agricultural interest prospered under the large exports and high prices, and manufactures began to be actively developed. The Secretary of the Treasury, Mr. Hamilton, in his celebrated report upon manufactures in 1791, says: "It is certain that several important branches have grown up and flourished with a rapidity that surprises, affording an encouraging assurance of successive future attempts." Among those enumerated as then flourishing are leather, iron, wood, flax, bricks, paper, hats, carriages, etc. It was computed that four-fifths of all the clothing of the inhabitants was made by themselves, and that great quantities of coarse cloths for table and bedding were manufactured in households. All these industries pertained mostly to the north, and their surplus formed at that time most of the exports of the whole country. The southern states were possessed of 600,-000 blacks, for whom there was no adequate employment. They were mostly engaged upon the production of tobacco and rice, but the market for them was not such as to afford much encouragement for the future. The increase of blacks who were not earning their support was not regarded with favor by southern statesmen under such circumstances: hence the incorporation into the federal constitution of the inhibition of the slave trade after 1808. That provision was resisted by the New England shipowners, of whose business the transportation of blacks, as a return cargo, after carrying produce to England, formed an important part. An event occurred in 1793, however, which wrought an entire change in the business of the country and the prospects of the south. Up to that time a little cotton had been raised, but the difficulty of freeing it from the seed was such that one hand could clean but 1 lb. per day, and even at 30 cents per lb. it was not profitable, under such conditions. The mode of carding and spinning it was also laborious and slow. At about that period the steam-engine in England was introduced as a motive power, and such inventions were made in the process of carding and spinning cotton as to enable one man to do the work that required 2,?00 by old methods. These were the conditions of an immense demand for the raw material. Providentially, precisely at that juncture, 1793, Eli Whitney, of Massachusetts, invented the cotton-gin, by which one hand, instead of only 1 lb., could clean 360 lbs. per day. Thus the market for cotton, and the means of preparing it, were both provided at once, and they were thenceforth to furnish the chief employment for American ships. The items of domestic exports in the above table were therefore varied as follows:—

| | Cotton. | Tobacco. | Flour & provisions. | Rice. | Manufactures. | Total. |
|---|---|---|---|---|---|---|
| 1700, | $42,285 | $4,349,567 | $5,991,171 | $1,753,796 | | $12,136,819 |
| 1803, | 7,920,000 | 6,209,000 | 15,050,000 | 2,455,000 | 2,000,000 | 31,179,000 |
| 1807, | 14,232,000 | 5,470,000 | 15,706,000 | 2,307,000 | 2,309,000 | 44,002,400 |

Thus cotton in a few years came to form nearly one-third of the whole exports, thereby supplying to the shipping in 1808 a compensating freight for the blacks, who were no longer to be imported. That cotton trade has not ceased to grow to the present day, and with ever increasing importance. It has supplied not only the manufacturers of Europe with raw material, but also those of the northern states. The impulse thus given to the cotton culture produced a vital change in the condition of the south, and this change is well indicated in the charge made by Judge Johnson, of Savannah, in 1807, in the case of a suit brought by Whitney to make good his claim to his patent.

"The whole of the interior," said Judge Johnson, "was languishing, and its inhabitants were emigrating, for want of some object to engage their attention and employ their industry, when the invention of this machine (the gin) at once opened views to them which set the whole country in active motion. From childhood to age it has presented to us a lucrative employment. Individuals who were depressed with poverty and sunk in idleness have suddenly risen to wealth and respectability. Our debts have been paid off, our capitals have increased, and our lands doubled in value. We cannot express the weight of obligation which the country owes to this invention. The extent of it cannot now be seen."

In these words we have the proof of the utter depression that then existed at the south, affording a strong contrast to the immense wealth that has since been developed.

The kinds and quantities of goods imported into the country were adapted to the wants of the people at that time, when luxuries had by no means so large a share of the public taste as is now the case. The homespun goods of the country were to be gradually supplanted by machine goods as these improved and cheapened, and they did so rapidly under the influence of larger supplies of raw material, operated upon by the most astonishing inventions in new machines, and the improved scientific processes applied to the manufacture. The American manufacturers were required to withstand not only the competition of the large capital and cheap labor of England, but the constant effects of new inventions, of which the first-fruits were manifest in imported goods. They therefore grew but slowly, and hardware, dry goods, and other leading branches of merchandise, continued to be imported. The aggregate amount retained in the country for consumption did not materially increase in the ten years up to 1807.

All branches of industry were in a high state of prosperity, when the course of events brought on the embargo, which produced an immense change in the course of affairs. All those interests that had thriven so well since the peace of 1783, became suddenly depressed by the circumstances which gave an impulse to manufacture. The raw material and farm produce which had been so actively exported now accumulated on hand at falling prices, tempting the manufacturer to employ the labor no longer occupied with commercial interests, and a new order of industry sprang into being. Trade was, however, not entirely interrupted; many coasting vessels, with suitable cargoes, were by pretended stress of weather driven into foreign ports, and the United States courts were filled with suits brought for breaches of the embargo acts. Under the non-intercourse act of 1809, business recovered to some extent, only to encounter those new vexations which brought on the war of 1812. That event rather changed the course of trade than interrupted it, and was succeeded by a greater degree of activity than ever. The imports and exports were as follows :—

| | Tonnage. | Domestic exports. | Foreign exports. | Total exports. | Total imports. |
|---|---|---|---|---|---|
| 1808, | 1,247,596 | $9,433.546 | $12.997,414 | $22,430,960 | $56,990,000 |
| 1809, | 1,350,281 | 31,405,700 | 20,797,531 | 52,203,231 | 59,400,000 |
| 1810, | 1,424,784 | 42,366,679 | 24,391,295 | 66,757,974 | 85,400,000 |
| 1811, | 1,232,502 | 45,294,041 | 16,022,790 | 61,316,831 | 83,400,000 |
| 1812, | 1.269,997 | 30,032,109 | 8.495,127 | 38,527,236 | 77,030,000 |
| 1813, | 1,166,629 | 25,008,152 | 2,847,845 | 27,855,997 | 22,005,000 |
| 1814, | 1,159.210 | 6,782,272 | 145,169 | 6,927,441 | 12,965,000 |
| 1815, | 1,368,127 | 45,974.403 | 6,583.350 | 52,557,753 | 113,041,274 |
| 1816, | 1,372,318 | 64,781.896 | 17,138,556 | 81,920,452 | 147,103,700 |
| 1817, | 1,399,911 | 68,313,500 | 19,358,069 | 87,671,569 | 99,250,373 |
| 1818, | 1,225.184 | 73,854,437 | 19.426,096 | 93,280,533 | 121,750,000 |
| 1819, | 1,260,751 | 50,976.838 | 19,165,683 | 70,142,521 | 87,125,000 |
| 1820, | 1,280,166 | 51,683,640 | 18,008,029 | 69,691,669 | 74,450,000 |
| | | $545,907,213 | $185,376,954 | $731,284.167 | $1,039,910,347 |

The large carrying trade that had existed in foreign produce gradually perished on the return of peace in Europe, throwing much tonnage out of employ; and domestic produce, although it found its way abroad to some extent, still fell in value, and accumulated in quantity in the home ports. Cotton in particular felt the want of the foreign market, although its presence in New Orleans became an instrument in the great triumph of our American troops over the British veterans who had just driven the French out of Spain. The same men who had routed the legions of Napoleon embarked at Bordeaux for New Orleans, to fall before the cotton bags defended by Jackson and his gallant band.

The course of events that had been productive of so much prosperity from 1783 to 1808, was followed in the next seven years by commercial disasters, it is true, but those disasters were relieved by the brilliant position assumed by the United States among the nations of the earth as a naval power.

The American tonnage, which increased to over 1,000,000 in 1807, had given employment to large numbers of hardy and skilful seamen, men whose professional skill and nautical daring had already made them famous, and had incited Great Britain to those impressments by which she sought to obtain the services of such able men. When her conduct drove the American government to embargo commerce, the employment of ships and men became restrained, and their daring manifested itself in infractions of the law. Non-intercourse and war drove them altogether out of employment, and they crowded into the navy and privateers. Up to that time England was the admitted mistress of the seas. Every nation in Europe had been driven from the contest. The best fleets of Napoleon, invincible upon land, had invariably struck to the British flag, and the feeble nation upon this continent, just formed out of revolted colonies, was hardly worth considering at all as a power. The proof of the contempt in which it was held was given in the conduct of the nations that forced non-intercourse and war upon the United States. It came very hard for all the thriving interests here to face ruin in the shape of war, but it became inevitable. So distrustful, however, was even Congress of the ability of the country to resist England, that it was determined, on the declaration of war, to send the government ships up the rivers, where they would be out of the reach of the dreadful English cruisers. It was only at the earnest solicitation of the leading officers of the navy that permission was finally given for the ships to go to sea. The astonishment in Europe, the dismay in England, and delight in the United States, could scarcely be equalled when the encounter on the seas resulted in the unprecedented spectacle of a series of triumphs over the tyrant of the ocean. In the short period of twenty years a power had arisen that was thenceforth to know no master upon the ocean, and submit to no insults, and this power had been born of commerce. The war closing with the defeat of the best troops of England, the "liberators of Spain," before the lines of New Orleans, left the United States no longer in the position of merely liberated colonies, but in that of a victorious power among the nations of the earth. It had cost much to win that position, but it was worth the struggle, since it ensured continued peace thereafter. The nations of Europe have not since thought it worth while to provoke new hostilities, but have, on the other hand, from time to time, settled up for the injuries they then committed upon American commerce.

The intervention of war had paralyzed every industry. The farm products that had been raised for export no longer had an outlet for the surplus; cotton, rice, and tobacco accumulated idly in warehouses. The ships were freightless at the docks, and all the earnings of industry were at their *minimum*. It was an advantage to manufacturers, indeed, to have no competition from abroad; but, on the other hand, the general depression of all other industries destroyed the home market for goods. The general depression of trade and the depreciation of property undermined all credits. Those who had contracted obligations to pay when merchandise was saleable and property convertible, could not pay when all values were paralyzed. In order to remedy this state of affairs to some extent, which was ascribed by certain parties to the want of a United States bank, new state banks were multiplied, under the erroneous notion that these could supply capital. Inasmuch, however, as the radical evil was inability to pay, increase of promises did not help the matter, and a general suspension of the banks took place. The country was filled with irredeemable paper; and the federal debt, which had been $75,463,476 on the consolidation of the revolutionary debt in 1790, had risen to $127,334,934 when peace took place in 1815. In such a state of affairs the return of peace brought with it a flood of imported goods, which amounted to $147,000,000 in 1816, giving the government a customs revenue equal to $36,306,874 in the year. The new United States Bank went into operation at the same time, causing for the moment additional pressure; but the sale of its stock, and of the federal government stock, subscribed to its capital, abroad, helped to correct the exchanges. The produce that had accumulated during the war also went forward in great quantities, giving a considerable impulse to the aggregate of domestic exports, which rose to $73,854,000 in 1818. Of this amount 40 per cent. was cotton. In some sort, the trade which had lain dormant during the war was forced into the first three years of peace. In the five years that ended with 1820 there was, consequently, great activity of trade, demanding greater banking facilities, thus promoting a restoration of confidence, and aiding the United States Bank in restoring order to the currency. The year 1820 brought with it new regulations in regard to the taking of the census, and a law of Congress was enacted for correctly keeping the import, export, and tonnage returns, which has since been done, and annually reported. The revenues of the government, which depended upon duties on imports, suffered interruption during the war, and a resort to taxation became necessary. This had been done in 1791 by a tax on houses and lands. A new valuation took place in 1815; and this, compared with the valuation of 1791, gives the progress of real property in all the states during that period. The census of 1820 comprised, in addition to the population, some items of the industry of the people. Comparing the leading aggregates at the two periods, the results are as follows:—

| | 1791. | 1820. | Increase. |
|---|---|---|---|
| Population Estimated. | 4,049,600 | 9,638,131 | 5,588,531 |
| Taxable land, acres.. | 163,746,686 | 188,286,480 | 24,539,794 |
| Valuation.......... | 479.293,263 | 2,275,730,124 | 1,796,436,861 |
| Imports ............ | 23,000,000 | 74,450,000 | 51,450,000 |
| Exports ............ | 20,205,156 | 69,691,669 | 40,486,513 |
| Tonnage ........... | 474,374 | 1,280,166 | 805.792 |
| Bank capital....... | 3,000,000 | 137,110,611 | 134,110,611 |
| Manufactures....... | 5 600,000 | 52,776,530 | 47,176,530 |
| U. S. debt .......... | 75,463,476 | 91,015,566 | 15,552,090 |
| " revenue ...... | 4,399,473 | 16,779,331 | 12,879,858 |
| Post offices, No. .... | 75 | 4,500 | 4,425 |
| Post roads, miles.... | 1,905 | 67,586 | 65,681 |
| Postal receipts ...... | 46,294 | 1,111,927 | 1,064,733 |

Such was the progress of the country in the first thirty years of its existence. Its population had increased 125 per cent. It had added five states to the Union, and 24,539,794 acres to its taxable property, the value of which had risen nearly fivefold. Its tonnage had increased threefold, its manufactures tenfold, and the capital employed in banking had been increased $134,-000,000. This great prosperity had manifested itself in face of a war with the greatest naval power the world had ever seen, and over which a decisive victory had been won. Commerce, under favorable circumstances, had been the basis of this great growth of wealth.

## CHAPTER II.

CHANGED INTERESTS—MANUFACTURES—COURSE OF TRADE—SPECULATION—REVULSION—BANKRUPT LAW—ENGLISH FREE TRADE—REVOLUTION IN FRANCE—FARMERS—GOLD.

The events of the war of 1812 had brought with them much experience. Up to that period great dependence upon foreign manufactures had existed. It is no doubt true that most of the common wearing apparel and similar goods were made in families, but iron ware, and most articles that enter into the materials of daily avocations, came from abroad. With the war came great deprivation, and many necessary goods, that had been abundant, were no longer to be had. Materials for the army and navy, of all sorts, particularly blankets for the men, were with difficulty obtained. This necessity gave a great spur to individual enterprise, and at the same time forced upon the government the idea of fostering home industry. This necessity was also apparent from the nature of the government. The federal Constitution had given to Congress the power to levy duties upon imports, and also direct taxes for its support. The former right was exercised up to the war, and the government finances were independent and flourishing. When, however, the war put an end to commerce, the government revenues also ceased, since, there being no imports, there could be no duties. Resort to taxation was then the alternative. The mode adopted by Congress was to apportion the amount required upon each state, and let the respective governments collect it. It was soon found that this was a very inefficient mode of proceeding, since the states could not be coerced, and the federal government was in danger of falling to pieces. The statesmen of the day saw the necessity of strengthening the government on the return of peace, and this was done by the same means as it was sought to encourage home manufacture, viz., by raising the duties upon imported goods. A new tariff was therefore enacted in 1816, increasing the duties, particularly upon cotton goods, in taxing which the *minimum* principle was introduced—that is, that the goods should pay 20 per cent. duty, but that the cost on which it was calculated should not be less than a fixed *minimum*. Thus, cotton cloth was to pay 30 per cent., but the cost must not be under 20 cents per yard, or 6 cents per square yard duty. The new duties, falling upon the large importations that followed the peace, rapidly swelled the revenues beyond the current wants of the government; at the same time, notwithstanding that the navy had so well discharged its duties in time of war, and the merchant marine had so well vindicated its ability to furnish sailors, Congress saw fit to pass a navigation act, by which the officers and three-fourths of the crews of American vessels should be American citizens. The act is of itself mostly a dead letter, since naturalization is carried on to an extent which makes the phrase "American citizen" a very ambiguous one. The object is desirable, but the means hampers trade, and does not effect the object. With the operation of the higher duties during the four years that ended with 1820, the imports diminished; the currency was contracted and restored to a specie basis; the exports of the country, that accumulated during the war, passed off; the proceeds had cancelled obligations, bringing the country into a better condition; and the federal government had been enabled to pay off a considerable amount of its debt. The countries of Europe had also become settled after the convulsion of war and the effects of peace. The Bank of England, that had been suspended for a quarter of a century, resumed payments, and trade generally began to resume its accustomed channels. Many currents of business had, as a matter of course, been disturbed. The large foreign carrying trade that had been enjoyed by American vessels was now resumed by the nations of Europe, and new currents of enterprise were to grow up, under new appliances. The capital of New England, that before the war had been exclusively employed in navigation and agriculture, was, by the events of the war, diverted to banking and manufactures, and was now growing in the last direction, banking having proved disastrous. The tariff of 1816 had been meant to aid them, and in 1818 and 1819 additions were made to the protective character of the duties. Cotton manufacture grew, and the great staple culture of the south—cotton—was developed, while Europe, no longer wanting so much food, the agriculturists became depressed. The manufacturing interest was therefore the favorite, and in 1824 a new tariff of higher duties was demanded and passed, to be succeeded by one of a higher grade of protection in 1828. The effect of these changes, with the steady nature of the demand for produce abroad, was to keep the imports and exports at moderate figures up to 1831, when a reduction of duties took place. In all that period, under the action of the United States Bank, and the annual payments of an average of some $7,000,000 by the government on its public debt, the currency was very steady, and commerce regular. The exports and imports for the ten years under those rising tariffs, were as follows:—

| | Dom. exports. | For. exports. | Total exports. | Imports. | Ex. specie. | Im. specie. |
|---|---|---|---|---|---|---|
| 1821, | 43,671.894 | 21,302,488 | 64,974,382 | 62,585,724 | 10,478,059 | 8,064,890 |
| 1822, | 49,874,185 | 22,286,202 | 72,160,387 | 83,241,511 | 10,810,180 | 3,369 846 |
| 1823, | 47,155,408 | 27,543,622 | 74,699,030 | 77,579.267 | 6,372,987 | 5,097,896 |
| 1824, | 50 649,500 | 25,337,157 | 75,986,657 | 80,549,007 | 7,014,552 | 8,379,835 |
| 1825, | 66,944,745 | 32,590,643 | 99,535,388 | 96,340,075 | 8,932,034 | 6,150,765 |
| 1826, | 53,055,710 | 24,539,612 | 77,595,322 | 84,974,477 | 4,704,533 | 6,880,966 |
| 1827, | 58,921,691 | 23,403,136 | 82,324,827 | 79,484,068 | 8,014,880 | 8,151,130 |
| 1828, | 50,669,669 | 21,595,017 | 72,264,686 | 88,509,824 | 8,243,476 | 7,489,741 |
| 1829, | 55,700,193 | 16,658,478 | 72,358,671 | 74,492,527 | 4,924,020 | 7,403,612 |
| 1830, | 59,462,029 | 14,387,479 | 73,849,508 | 70,876,920 | 2,178,773 | 8,155,964 |
| | $536,105,024 | $229,643,834 | $765,748,858 | $798,633,400 | $71,673,494 | $69,144,645 |

If we compare this period of ten years with the ten years of comparative quiet immediately preceding the war, we shall find the following aggregate results:—

| | Imports. | Re-exports of foreign goods. | Domestic exports. | Total exports. |
|---|---|---|---|---|
| 1798—1808, | $956,470,000 | $422,500,000 | $393,700,000 | $816,200,000 |
| 1821—1831, | 798,633,427 | 229,643,831 | 536,104,918 | 765,748,752 |
| Decrease | $157,836,573 | $192,856,166 | | $50,451,248 |
| Increase | | | $142,404,918 | |

The decrease was altogether in the foreign goods, or colonial produce brought into the country during the European war for reshipment to Europe; while the increase in domestic exports was mostly cotton, that article forming three-fifths of the whole value exported. The exports of flour and provisions were limited, but manufactures began to form an item in the exports. It is to be borne in mind that Great Britain had made great efforts after the war, when her navigation laws were modified, to concentrate the trade of the world in her warehouses. Inducements were held out by facilities of entry and advances on merchandise to attract thither the produce of all nations, because, under such circumstances, not only did the British manufacturers have within their reach the raw materials of all manufactures, but trading vessels had, in those ample warehouses, every variety of goods to make up an assorted cargo for any voyage in the world, and make of them the medium of selling British goods. Thus, all the new countries of America, Africa, and Asia offered markets which would absorb small quantities of a great variety of articles, but a cargo of any one description would glut them. To make a profitable voyage, therefore, the cargo should be composed of such a variety of wares as would all sell to advantage. If Virginia was to send a whole cargo of tobacco to Africa, a portion of it would sell, and the remainder be a dead stock, and the voyage a losing one. The same thing would happen to a cargo of rum, or calicoes, or gunpowder, or hardware, or the infinite variety of articles that make up the wants of a small community. If a vessel's cargo should be composed, in proper proportions, of all these articles, the whole would sell well, and the voyage pay; but for a vessel to go round to places where each of these articles is to be had, and so collect a cargo, is expensive, and would still result in loss. The English warehouse system sought to supply a want here by attracting into them all possible descriptions of tropical and other produce. A ship might then make up her cargo for any part of the world at the smallest average expense, and every cargo was sure to be completed with British manufactures. Under such circumstances, they could compete with any other nation. The advantage was so manifest, that American ships would go out in ballast to England, to fit them out for Asiatic markets. It resulted from this that England continued to be the recipient of most American produce, not only for her own use, but for re-export elsewhere. With her large capital she advanced on the produce, and so controlled it, becoming the banker for the Americans. The nations of the continent, slowly recovering from the effects of the long wars, began to manufacture such articles as found sale in the United States, while they did not purchase largely in return. China furnished teas and silks, and got its pay by bills drawn against American credits in London. The new bank of the United States operated the credit, giving the China merchant a six months' bill on London, which he took in preference to silver, which he before remitted. These bills were paid out for the tea, and by the Hong merchant, who received them, were paid to the British East India merchant for opium or raw cotton. By the latter it was remitted to London, where it was met by the funds already provided through the United States Bank, by sales of American produce. This centralization of trade in England became, however, inconvenient. The American ships that now began to carry cotton, tobacco, rice, and some breadstuffs to Europe, had thence no adequate return freights, because those countries did not as yet offer a good supply of merchandise. Soon, however, there sprang up an increasing migration to the United States from Germany across France *via* Havre, and these passengers became a desirable return freight, causing a change in the model of the ships engaged in the trade. By this means the freight was reduced, or rather the ship could carry cotton out cheaper, since she was no longer compelled to return empty. The result was, therefore, cheapened transportation, in the same manner that the modification of the navigation laws, enabling ships to carry cargoes both ways, had cheapened freight. The increasing exports, and the weight of the tariff of 1828 upon imports, had so operated upon exchanges as to cause an excess of specie to be imported to the extent of some $15,000,000 in the last few years. This influx accumulated in banks, and disposed them to inflate the currency, thereby inducing imports at a moment when reductions in duties were made by the tariff of 1831; and this inflation was aided by the conflict which then began between the United States Bank and the government in relation to the recharter of the institution. These circumstances laid the foundation for the great speculation which followed. The high tariff of 1828 had produced much agitation, that promised serious difficulties. The northern, or New England states, whose interests were originally commercial, opposed the war, because it was destructive of those interests. Their capital was turned by it into manufactures, and they demanded protection for that interest. This was acceded to, because all parties had witnessed the evils of a dependence upon foreign nations for manufactures, and also because the federal government needed strengthening by the support which high duties would give it. In 1830 the manufactures had enjoyed fifteen years of protection, and should be firmly rooted. The federal government, from being too weak, had become too strong. The public, who consumed goods foreign and domestic, were paying too high a tribute for the support of the manufacturers, and the states felt their rights encroached upon by the growing power of centralization. A change of policy in respect of the tariff was insisted upon, and a reduction took place in 1831, many goods being made free. In 1832 Mr. Clay's compromise was passed, by which biennial reductions were to take place, until, in 1842, all the duties should be reduced to a general level of 20 per cent. ad valorem. These reductions in duties, at a time of bank inflation and speculation, eminently promoted those imports which, under such circumstances, were carried to excess.

The manufactures of the country had largely increased during the ten years up to 1830. The capital employed in cotton manufacture at that date was $40,614,984. There were 795 mills, working 1,246,503 spindles and 33,506 looms. They produced 230,461,000 yards of cloth, that weighed 59,604,926 lbs., and was worth $26,000,000. These mills employed 117,626 persons, whose wages were $10,294,944 per annum. This was a large interest grown up in cotton. The progress of manufactures generally was given by the census, as follows:—

| | 1820. | 1830. |
|---|---|---|
| Cotton | 4,834,157 | 40,614,984 |
| Wool | 4,113,068 | 14,528,166 |
| Pig iron and castings | 2,230,276 | 4,757,403 |
| Wrought iron | 4,640,669 | 16,737,251 |
| Brewers and distillers | 4,876,486 | 3,434,808 |
| Salt | 1,852,258 | 935,173 |
| Other articles | 29,919,621 | 46,077,092 |
| Total | $52,466,535 | $127,084,877 |

In the considerable increase of interests, here apparent, many of the factories suffered by home competition, when too much capital had been induced, by hope of protection, to go into the business. The operations of these manufactures no doubt produced a local demand for materials and food; but this did not suffice, however, in the absence of a foreign demand, to support prices of farm produce, in face of the large development given to agriculture by the increasing immigration and settlement of the western lands.

The season of speculation which now seized the public mind was one of the most remarkable in the history of commerce. There is no doubt that it had its origin in the great success which had hitherto been manifest in the progress of the country. Those who had seen but thirty years of active life had witnessed the most extraordinary growth of numbers and wealth in the whole country, and in cities particularly. The highest prizes had attended those who had held land at the points favorable to trade, which trade was the foundation of cities. There seemed hardly any limit to the rise that might take place in the value of property, and so liberal were bank accommodations, there was very little difficulty in procuring the means to hold land. In almost all cities, the early settlers had become possessed of land cheap. The rapid growth of trade, bringing in numbers to occupy those lands for stores and dwellings, caused a competition that raised rents and values rapidly in price. The effort was then to become possessed of land for speculation, and this effort was attended with the wildest excitement; a few hours sufficed to place a moderate fortune in the hands of the buyer, and prices rose to a fabulous extent in a short time. From the cities, the excitement spread all over the Union, and productive employments were neglected to trade in lands; at the same time, the fictitious fortunes made by these means stimulated expense, and the wealth of the country was diminished by a double process—by lessened production, and increased consumption—"the candle was burned at both ends," and there could be little surprise that it was speedily consumed. The course of the trade for the ten years up to 1840 was as follows:—

| | Dom. exports. | For. exports. | Total exports. | Imports. | Ex. specie. | Im. specie. |
|---|---|---|---|---|---|---|
| 1831, | $61,277,057 | $20,033,526 | $81,310,583 | $103,191,124 | $9,014,971 | $7,305,945 |
| 1832, | 63,137,470 | 24,039,473 | 87,176,943 | 101,029,266 | 5,656,340 | 5,907,304 |
| 1833, | 70,317,698 | 19,822,735 | 90,140,433 | 108,118,311 | 2,611,701 | 7,070,368 |
| 1834, | 81,034,162 | 23,312,811 | 104,346,973 | 126,521,332 | 2,076,758 | 17,911,632 |
| 1835, | 101,189,082 | 20,504,495 | 121,693,577 | 149,895,742 | 6,477,775 | 13,131,447 |
| 1836, | 106,916,680 | 21,746,360 | 128,663,040 | 189,980,035 | 4,324,336 | 13,400,881 |
| 1837, | 95,564,414 | 21,854,962 | 117,419,376 | 140,989,217 | 5,976,249 | 10,516,414 |
| 1838, | 96,033,821 | 12,452,795 | 108,486,616 | 113,717,404 | 3,508,046 | 17,747,116 |
| 1839, | 103,533,891 | 17,494,525 | 121,028,416 | 162,092,132 | 8,776,743 | 5,595,176 |
| 1840, | 113,895,634 | 18,190,312 | 132,085,946 | 107,141,519 | 8,417,014 | 8,882,813 |
| | $892,899,909 | $199,451,994 | $1,092,351,903 | $1,302,676,082 | $56,839,933 | $107,469,096 |

This period of commerce shows remarkable results, since it illustrates the nature of the pure speculation that possessed the country. In the period up to 1830, the imports had exceeded the exports $32,884,675, or 5 per cent. in the whole ten years, an amount which was not more than healthy. In the succeeding ten years, the excess of imports over the exports was $210,334,181, or 20 per cent., and this took place although the exports were valued at inflated prices, which were not realized abroad. The course of business at that period required shipments of American produce, mostly cotton, to firms abroad, who made advances on the consignment at a certain ratio, less than the face of the invoices. The produce was then afterward sold for the account of the owner, and not unfrequently did not bring the amount of advances. Thus, if cotton was shipped at 16 cts. per lb., and 12 cts. advanced, the amount realized might be only 11 cts. Hence, the real exports of the country were not always measured by the export value. On the other hand, the goods imported were mostly ordered by importers here, and purchased on credits in the manufacturing districts. These credits were operated through large London houses connected with the American trade, and whose ability to extend credits depended upon the indulgence of the Bank of England, and that institution itself was subject to pressure whenever the harvests should fail. The system of credits was open, however, up to 1836, in England, under apparently favorable circumstances. The United States and rival banks here favored the extension of credits in every possible way; and the goods bought on credit in Europe were sold on credit here, and consumed by those who held fortunes based upon the apparent rise in lands bought on speculation, for promises. The numbers so engaged diminished production, while luxuries were imported more rapidly than ever. The returns of certain articles of domestic exports and imports, indicate the extent of this process as follows:—

| | Imports. | | Imports. | | Exports. | |
|---|---|---|---|---|---|---|
| | Silks. | Wines. | Spirits. | Sugar. | Flour. | Provisions. |
| 1831, | $5,932,243 | $1,673,058 | $1,037,737 | $4,910,877 | $10,461,728 | $17,538,227 |
| 1832, | 9,248,907 | 2,397,479 | 1,365,018 | 2,93?,688 | 4,974,121 | 12,424,703 |
| 1833, | 9,498,366 | 2,601,455 | 1,537,226 | 4,755,856 | 5,642,602 | 14,209,128 |
| 1834, | 10,998,064 | 2,944,388 | 1,319,245 | 5,538,097 | 4,560,379 | 11,524,024 |
| 1835, | 16,677,547 | 3,750,608 | 1,632,681 | 6,806,425 | 4,394,777 | 12,009,399 |
| 1836, | 22,980,212 | 4,332,034 | 1,917,381 | 12,514,718 | 3,572,599 | 10,614,130 |
| 1837, | 14,352,823 | 4,105,741 | 1,470,802 | 7,203,206 | 2,987,269 | 9,588,359 |
| 1838, | 9,812,338 | 2,318,282 | 1,476,918 | 7,586,825 | 3,603,299 | 9,636.650 |
| 1839, | 21,752,369 | | | 9,929,502 | | 14,147,779 |
| 1840, | 9,835,757 | | | 5,580,950 | | 19,067,535 |

Thus, while the import of silk rose from less than $6,000,000 to nearly $23,000,000, and the four articles, including wine, spirits, and sugar, from $13,550,000 in 1831, to $41,850,000 in 1836, the export of provisions, notwithstanding the high prices, fell from $17,538,227 to $10,614,130. So great had been the decline in production, that in the last-named year, 1836, wheat was actually imported at $2 per bushel, from Russia, on credit, to feed land speculators in the west. The mania for land speculation was fed by bank bubbles, and large sums were drawn from the east as well as Europe, for the creation of banks west and south-west. The transmission of these sums was the means of credits by which goods were consumed. There were created in the period from 1830 to 1840, 577 banks, having an aggregate capital of $218,000,000. These banks were mostly started west and southwest, with eastern capital paid in subscription to the bank stock, and with tate bonds issued in aid of the banks. Thus a stream of credit issued from London, which, aided by circumstances, poured over the Union, checking industry, exhausting capital, and raising prices. The harvests of England had been good for some years, and the importation of corn had ceased. As a consequence, exchanges were in favor of England, and the bank disposed to be liberal. It was so to the American houses in London. These houses were thus enabled to grant credits to United States importers of goods who made their purchases in Lancashire. The goods arriving in the United States, were sold to jobbers and through the auction houses at long credits, and these were payable at the local banks started all over the country. The quantity of goods thus sold was increased by the large fire in New York in December, 1835, by which it was estimated $18,000,000 worth of property was consumed. These goods were replaced on credit, and the city rapidly rebuilt by the same means, adding much to the accumulating liabilities. At the same time, as we have seen, $200,000,000 were sent from the east to the west to start banks. These banks were also authorized to issue paper to circulate as money; and capital and circulation were loaned to those who purchased and consumed goods. Thus, while the city merchants were selling their goods to the dealers of the interior, on credit, the capitalists were sending money in the same direction, with which to start banks; these were to lend the dealers the means of taking up their notes. As long as this lasted, business was brisk; but it soon came to an end. The federal government had also been a party to the excitement, by selling its lands on credits to speculators, and the amount of these sales became enormous, when suddenly the government issued its famous "specie circular," by which the lands were to be paid cash in specie. This was the first blow to the credits. The government, determined to curtail all credits, had made peremptory demand upon France to pay the indemnity long since due. This payment took place, and was received at this juncture very opportunely in gold. The capital of England, which had been loaned so freely all over the world, began to run short. The harvests, also, which for so many years had sufficed for the national wants, suddenly failed, in 1836, and it became necessary to import corn for cash. This circumstance caused exchanges to run higher against England, and the bank began to contract. Its first notice was in August, 1836, to the American houses to curtail their credits. This was the signal for payment through the whole line of credits from the Bank of England to the western consumer of goods. The pressure became intense, and in May, 1837, every bank in the Union had suspended their payments. The three large American houses in London, known as the "three W's," Wildes, Wiggins, and Wilson, failed for many millions, and their assets consisted of the credits they had granted American importers. The latter stopped in great numbers, with assets due from dealers all over the country; and the latter stopped with large assets due from speculators who held land at paper prices, and who insisted that a return of paper inflation would enable them to pay. The banks of the interior had large sums due them from speculators who held land, as well as from shopkeepers who had trusted consumers. The shopkeepers had bought of the merchants in eastern markets, and had given notes payable at their local banks. Those notes were generally sent for collection through the city bank to its country corresponding bank, and on their maturity were met by a discount of the maker's note by the local bank. This mode of payment only transferred the debt from the merchants to the bank, and was possible only as long as the eastern bank did not claim the balance due it. When that was done, failure took place. A great struggle was made to restore that inflation, particularly by the United States Bank, which, with its southern and western dependents, felt that unless the debts contracted all over the country in an inflated currency, could be paid in a similar currency, they could not be paid at all. Public opinion was, however, bent on resumption, and January, 1839, it took place. The United States Bank sought to create foreign credits by obtaining state stocks on credit, and, by selling them in Europe, aid the exchanges. It also entered the cotton market as a monopolizing buyer. The institution, on the expiration of its United States charter, had obtained a new one from Pennsylvania. When it went into operation as a state institution, its old bills had been called in, and new ones issued. When it struggled to maintain its resumption in 1839, it had the boldness to exhume its old bills and pay them out for cotton at almost any price, which cotton was sent to its agents in Liverpool for sale, and against which to draw sterling bills, which it sold in New York for cash; thus forming a kiting operation. At the same time, it had obtained some $15,000,000 of state stocks from Mississippi, Michigan, Indiana, Illinois, and other states, on similar terms, and these were sent to London for sale; but not selling readily, they were pledged to cover bills drawn by the bank. All these plans were insufficient to sustain the institution under its load of debt, and it became evident that nothing short of a second general suspension of the banks could save it. This it undertook to bring about by selling in the New York market its bills on France and England to any amount, and drawing the proceeds from the New York banks in specie. This course was pursued through August, 1839; when, early in October, the news came that the bills so sold in New York on France had

CLIPPER SHIP.

OUTWARD BOUND, LADEN WITH COTTON—RETURN TRIP WITH EMIGRANTS.

been protested. The bank then finally failed, and went into liquidation, when it was found that more than its whole capital had been lost. This event carried with it most of the banks in the country that had followed a similar policy. Liquidation then became general, and went on up to 1843, when the lowest point of credits was reached. The short harvests of England, that were the immediate cause of the explosion in 1837, were also the cause of a gradual restoration of sound prosperity in the United States, by reviving a demand for the products of land. This was the more readily done that the fictitious paper prices that prevented American farmers from competing with those of Europe, had disappeared with the bank stoppages. The farmers had nominally sold their produce well, but they had taken pay in bank paper, which the revulsion left valueless in their hands. The process of liquidation swept several hundred banks out of existence, but there remained an immense load of debt due by individuals, to relieve whom Congress, in 1841, passed a bankrupt law. The operation of the law relieved 39,000 persons, from debts to the amount of $441,000,000. The disasters involved the failure of several states, with an aggregate debt of $100,000,000. The banks that were liquidated had an aggregate capital of $200,000,000. Thus, the recorded losses were as follows:—

| | |
|---|---|
| States | $100,000,000 |
| Bankrupt debts | 441,000,000 |
| Bank capital | 200,000,000 |
| | $741,000,000 |

The debts that were settled without the intervention of the law, were supposed to be equal to those legally discharged, but the amount recorded is an enormous sum. In consequence of those disasters, many states, in revising their constitutions, forbade the authorization of more bank charters.

While speculation had thus run riot, during the ten years up to 1840, consuming the available capital of the country, the population had not failed to increase and extend itself over the face of the country. Many of the states had projected large works, for the construction of which they had contracted debts; and the expenditure upon the works had attracted laborers, who ultimately became settlers. The sales of public lands had been very large, but these had to a great extent been taken up by speculators, and this operation in some degree prevented actual settlement. All these lands were now pressing upon the market, and the distress in cities attending the subsidence of building and other employments, drove crowds upon farming lands, laying the foundation of future prosperity. During the speculative years, the commercial cities increased most rapidly; and with the revulsion, the agricultural states took the lead. The cotton culture had received a great impulse during the same period, by means of the banking credits. The old lands of the Atlantic states were capable of producing cotton at 6 cts. per lb., but it was found that the new lands of the Mississippi valley would produce it at a much less rate. The migration of planters with their hands then took place to the new lands of the west, and the means of so doing were supplied to a great extent by the state bonds issued in aid of banking capital. These institutions made loans to the planters on security of the crops. Under this spur, large tracts of land were got under cultivation, disastrously to the banks, but favorable to a large supply of cotton, of which the export became large.

The ten years, 1841 to 1850, thus opened under great depression. The receipts of the federal government, in consequence of the revulsion of trade in 1837, had fallen far behind its expenses, while the duties under the biennial reductions of the compromise tariff were approaching their lowest grade of 20 per cent., and it became necessary to restore the duties, in order to procure revenue. The utter failure of the United States Bank, of which a large portion of the stock was sent abroad; the failure of so many states, some of which repudiated their debts altogether; and the bankrupt law, which had expunged so large a volume of private debts, had produced so much discredit abroad, that a 6 per cent. stock of the federal government was utterly unsaleable, notwithstanding that in 1835 the last dollar of the old national debt had been paid in full. Congress, therefore, in 1841, passed an act levying 20 per cent. duties on a long list of articles before free, and in 1842 raised the general level of duties. At this juncture there had been no plan of settling the state debts, and efforts to restore the national bank failed. Amid these adverse circumstances, however, industry revived from the ruins of speculation, and the foreign commerce was placed upon a more liberal footing. The English government, taught by the experience of the past, had decided to relieve commerce from many restrictions, and in 1842 modified her corn laws, and admitted provisions, which had previously been prohibited, to entry, at comparatively low duties. The first opening of the trade to provisions—cheese, butter, etc.—was not at once successful; many attempts were required, and much perseverance, before the American articles became properly prepared for and appreciated in the English markets. Success, however, ultimately attended the trade, and a large opening to western produce was made, that has proved of a permanent nature. This circumstance gave an impulse to commerce, which was greatly accelerated by the failure of the potato crops in 1845 and 1846. That event was of so grave a nature as to lead to the abrogation of the corn laws altogether, and also to a suspension of the navigation laws in England, France, Holland, and Belgium, for the reason that the shipping was inadequate to the transportation of food. The course of commerce during the ten years, 1841 to 1850, was as follows:—

| | Exports. Domestic. | Exports. Foreign. | Total. | Imports. | Of those amounts. Specie. Exports. | Of those amounts. Specie. Imports. |
|---|---|---|---|---|---|---|
| 1841, | $106,382,723 | $15,469,081 | $121,851,804 | $127,946,177 | $10,034,332 | $4,988,633 |
| 1842, | 92,969,996 | 11,721,538 | 104,691,534 | 100,162.087 | 4,813,539 | 4,087,016 |
| 1843, | 77,793,783 | 6,552,697 | 84,346,480 | 64,753,799 | 1,520,791 | 22,320,335 |
| 1844, | 99.715,179 | 11,484,867 | 111,200,046 | 108,435,035 | 5,454,214 | 5,830,459 |
| 1845, | 99,299,776 | 15,346,830 | 114,646,606 | 117,254,564 | 8,608,495 | 4,070,242 |
| 1846, | 102,141,893 | 11,346,623 | 113,488,516 | 121,691,797 | 3,905,268 | 3,777,732 |
| 1847, | 150,637,464 | 8,011,158 | 158,648.622 | 146,545,638 | 1,907,024 | 24,121,289 |
| 1848, | 132,904,121 | 21,132,315 | 154,036,436 | 154,998,928 | 15,841,616 | 6,360,224 |
| 1849, | 132,666,955 | 13,088,865 | 147,755,820 | 147,857,439 | 5,404,648 | 6,651,240 |
| 1850, | 136,946,912 | 14,951,806 | 151,898,718 | 178,138,318 | 7,522,994 | 4,628,792 |
| | $1,131,458,802 | $129,105,780 | $1,262,564,582 | $1,267,783,782 | $65,012,921 | $86,835,932 |

In these aggregates we have the reverse of the trade during the ten years to 1840, since the imports scarcely exceeded the exports, including specie; and exclusive of specie, there was an excess of $14,677,036 exports over imports. The exports of domestic produce had become very considerable. The large breadth of land that had been brought under cotton, and the rapid settlement of farm lands after the revulsion, had laid the foundation for an extended production, while the means of transportation had been so much increased, as to equalize prices at a lower level on the seaboard, and supply a far larger quantity for shipment than had been possible before. Nevertheless, the demand became so urgent in the three years ending with 1847, as to tax every means of transportation to its utmost capacity, and to carry freights to an inordinate height, notwithstanding the suspension of the navigation laws in England.

The demand for food abroad had superseded all other demands to a considerable extent. The necessity of carrying food raised the freights so high, that other materials would not pay to carry; the more so, that it is a well-known effect of dear food, to lessen the purchase of clothing and other articles. Hence, when the market for cloths was lowest, the freight on the materials was highest. The condition of Ireland made it necessary to introduce Indian corn as a substitute for potatoes. This was by great efforts accomplished in a degree, and thereby a permanent market made for corn. That article of food is, however, very far from being popular with the people. The effect of the famine, joined to the general influence of the change of English policy, was to carry up the domestic exports from $106,000,000 in 1841 to $150,000,000 in 1847. This increase was almost entirely due to breadstuffs and provisions, which reached a value of $68,761,921 in 1847, being nearly one-half the whole domestic exports for that year. The large sale of western produce so inaugurated gave an unusual stimulus to the activity of internal trade, and to the value of western lands and credits; and the foundation was thus laid for the movement which so singularly culminated in 1857.

While the famine demand of 1846 caused so large an export of American produce, in return for which merchandise was necessarily to be received, the federal government recovered from the embarrassments induced by the revulsion. It was, however, still embarrassed, but this time with a surplus, rather than a revenue; and in 1846 the tariff was again revised, so as to reduce the general average of duties some 7 per cent. The principle of protection was finally disavowed, and that of revenue only admitted as a rule of action. This reduction of duties naturally gave a spur to importation, at a moment when the exports were very large. There was at that time, however, no speculative action in this country, nor much inflation of credit, by which large quantities of goods could be suddenly placed; and the sales of produce were so prompt, as to throw a large cash balance in favor of the country: hence, of the imports of 1847, $24,121,289 were in specie—the largest amount ever imported from abroad in one year—a fact which imparted much activity to trade; and in the following year, when the exports of farm produce declined, $15,841,616 of that specie returned whence it came. That re-export was, however, much stimulated by the extraordinary political convulsions that overtook Europe in February, 1848. The peculiar theories avowed by the successful revolutionists in relation to property, which was declared to be "robbery," greatly alarmed the public mind, and tended to make French property utterly unsaleable for the moment. The consequence was the most active shipment of money, silver particularly, with which to purchase the cheap goods of France. The panic soon passed, but depression continued under the provisional government, which, in order to encourage industry and employ workpeople, gave the manufacturers orders for goods, and allowed a drawback of 10 per cent. on merchandise exported out of France. This state of affairs caused the importation thence into the United States to be larger. Among the goods so imported was a quantity of Lyons silk, which had been ordered by the government with the view to employ the operatives. As the government had given no directions as to colors, the whole was made up, to the extent of 10,000,000f., in tricolor. A large portion of this was bought by a New York house, and gentlemen's coats for a long time had tricolor sleeve linings. With the institution of the new government in France, confidence returned, and new branches of trade were opened with France, as well as other countries of the continent, which began to be rivals for the American trade. The Germans and Belgians had so far advanced in the production of certain manufactures, as to dispute the French and English pretensions to supply the United States, and credits began once more to form the medium of extended sales of foreign merchandise. The competition was now, however, far more severe with the home manufactures, which were so far advanced as not only to maintain themselves against new competition, but to drive out those which had long held the field in particular goods. The balance of the ten years' business was, notwithstanding, very small. The period closed, however, with one of the most remarkable discoveries of modern times. We allude to the gold discoveries in California. The war, which carried Americans to California, gave them the opportunity to discover, and the "dust" was soon detected in the neighborhood of Captain Sutter's fort. The intelligence was received with great incredulity. The learned said the location and character of the gold was contrary to all precedent; but soon the metal came, and was satisfactorily assayed. Each successive arrival brought stronger confirmation, and about $9,000,000 worth was received in 1850. Since then, the amount received has been more than $52,000,000 worth per annum.

The decade ending with 1860 was one of the most extraordinary in the history of commerce. It commenced with a confirmation of the astounding gold discoveries in California, followed by as important a discovery of the same nature in Australia. These events deeply stirred the commercial mind throughout the world, coming, as they did, at the moment when the political difficulties of Europe had settled down in a manner to win public confidence in continued peace and security. The discovery of such large supplies of gold induced the general belief that the metal would depreciate, as compared with commodities and silver, and that the depreciation would manifest itself in a rise in prices of all industrial products. Serious apprehensions were entertained through this superficial view of the case, particularly in Europe, where a large class are rich on fixed annuities, or in the receipt of a fixed amount of money per annum. If all property was to rise in value, leaving the amount of rents the same in money, it would be equivalent to ruining creditors for the benefit of debtors. Thus, if a farmer had mortgaged his farm for say $5,000, the annual interest at 6 per ct. would be $300; at an average price of $1 per bushel for wheat, it would require 300 bushels per annum to pay the interest, and ultimately 5,000 bushels to pay the principal. If the mortgage run five years, he would be required to give, altogether, 1,500 bushels for interest, and 5,000 bushels for principal—together, 6,500 bushels. If, through the influx of gold, prices came permanently to be $2 for wheat, it would at once reduce the quantity per annum that he would have to pay to 150 bushels, and the ultimate amount for principal to 2,500; in other words, he would save half his grain, at the expense of his creditor, and the money value of his farm would be doubled. This would be of no benefit to him, beyond the discharge of his debt, because the value of all that he had to purchase would rise in the same proportion. All creditors would lose half that was due them. This was an important consideration for the debt-covered countries of Europe, where so large a portion of the people are creditors of the governments. In Holland, to avoid this, they passed a law doing away with gold as a legal tender, and making silver the only medium of payment, under the impression that silver would rise in the same proportion as other commodities. In the United States, the same impressions were entertained, but the event showed that the fears were groundless. But this view naturally stimulated the production of commodities that were to rise in value, and industry became unusually active, since all classes wished to profit by the anticipated rise. Above all, commercial enterprise and migration tended strongly to the gold countries, the direct source of the anticipated benefits. A vast amount of capital was sent to both California and Australia. The United States shipped to the latter country, in 1853, a large amount of goods; and to California the drain continued on a very extensive scale, with small renumeration to the shippers. The production of gold during the decade was $600,000,000, and it cost an equal amount of capital. In other words, there had been no profit on the production. The capital that it cost exists in the gold itself, and in the cities and property of California. From nearly all nations the capital that now constitutes the wealth of California, flowed thither in exchange for the gold. While these great mining enterprises were in course of prosecution, another of equal magnitude was undertaken: the construction during that decade of 21,000 miles of railroads, at a cost of $750,000,000. The capital for the enterprise was drawn from Europe, in the shape of money and iron, and from the eastern states, in subscriptions to stocks and bonds. These did not all turn out well, but the capital expended remained in the shape of railroads that were ready and efficient means of developing future trade. The speculative investments in lands and western property also ran to an inordinate extent in the same period, and nearly $500,000,000, on the best estimates, took this direction, following the trail of American migration, from the eastern to the western states, impelled by the large immigration from Europe. As we have seen elsewhere, 2,518,054 persons arrived from abroad in the period here mentioned. These persons brought with them, at the usual estimate of $100 per head, $251,805,400 in capital, as money and goods. A large portion of this was expended in transportation expenses and in settling new homes. We have, then, the following estimated items of extraordinary expenditures in the ten years, 1850 to 1860:—

| | |
|---|---|
| Capital sent to California, | $600,000,000 |
| " spent in 21,000 miles of railroad, | 750,000,000 |
| " expended in land operations, | 500,000,000 |
| " expended by newly-arrived immigrants at fifty dollars each, | 125,900,000 |
| Total extraordinary expenditures, | $1,975,900,000 |

The 300,000 persons who went to California to consume the capital sent thither, returned $600,000,000 worth of gold, of which a large portion went to Europe, whence goods came. The railroad expenditure resulted in effective investments in trade. The land investments were not "active," for the time, but were not entirely lost. The immigrants were mostly at work, producing capital in new states.

While these large expenditures took place in the United States, Europe incurred a heavy loss in the failure of her corn harvests, that she was obliged to make good from the corn crops of the United States. She also incurred a heavy expense in the Russian war, which returned very little for the investment, but which required a larger supply of American produce, particularly pork, whiskey, but of gold, above all. The loss of her vine crops, also, brought American whiskey in demand, as a substitute, and thereby, possibly, cut off a supply of genuine grape liquors for the United States, from France. Those events caused a larger demand for produce, at a time when the expenditures for gold, rails, and land were so active. It is not a matter of surprise, under all these circumstances, that the gold diggers, road builders, speculators, and emigrants, so well supplied with money, should require a larger quantity of goods, both manufactured and imported, while similar activity in Europe, in addition to war and short crops, demanded more raw materials. The import and export table, therefore, shows higher figures than ever before, as follows:—

| | Exports. Domestic. | Exports. Foreign. | Total. | Imports. | Of these amounts. Specie. Exports. | Of these amounts. Specie. Imports. |
|---|---|---|---|---|---|---|
| 1851, | $196,689,718 | $21,698,293 | $218,388,011 | $216,224,932 | $29,472,752 | $5,453,503 |
| 1852, | 192,368,984 | 17,289,382 | 209,658,366 | 212,945,442 | 42,674,135 | 5,505,044 |
| 1853, | 213,417,697 | 17,558,460 | 230,976,157 | 267,978,647 | 27,486,875 | 4.201,382 |
| 1854, | 253,390,870 | 24,850,194 | 278,241,064 | 304,562,381 | 41,281,504 | 6,939,342 |
| 1855, | 246,708,553 | 28,448,293 | 275,156,846 | 261,468,520 | 56,247,343 | 3,659,812 |
| 1856, | 310,586,330 | 16,378,578 | 326,964,908 | 314,639,942 | 45,745,485 | 4,207,632 |
| 1857, | 338,985,065 | 23,975,617 | 362,960,682 | 360,890,141 | 69,136,922 | 12,461,799 |
| 1858, | 293,758,279 | 30,886,142 | 324,644,421 | 282,613,150 | 52,633,147 | 19,274,496 |
| 1859, | 335,894,385 | 20,865,077 | 356,759,462 | 338,768,130 | 63,887,411 | 7,434,789 |
| 1860, | 373,189,274 | 26,933,022 | 400,122,296 | 362,166,254 | 66,546,239 | 8,550.135 |
| | $2,745,109,155 | $228,883,058 | $2,983,872,213 | $2,922,159,539 | $495,111,813 | $77,687,934 |

The imports rose steadily to over $300,000,000 in 1854, under the first Australian and Californian excitement, and took larger dimensions as the railroad operations progressed. Railroad iron figured largely in the amount in exchange for bonds. The imports of silks rose from $13,731,000, in 1850, to $30,636,000. The most remarkable rise in the importation was, however, in sugar, which, from $11,000,000, rose to nearly $55,000,000, in 1857, in consequence of the failure of the Louisiana crop, at a moment of very active demand. So high a figure to be paid for sugar at a critical moment went far to disturb the exchanges, and aid the panic of 1857. We find that the whole amount of importations for the ten years reached $2,922,159,539, exceeding, by $1,654,375,757, the importations of the previous ten years. This excess of expenditure corresponds with the estimated amount of capital expended for extraordinary purposes, since a considerable portion of the expenditures was applied to domestic manufactures. The operation of the treaty with Canada produced a somewhat larger receipt of foreign goods. These also swelled proportionately the aggregate imports. The excitement manifest in the United States in regard to gold and railroads, was also present in England and Europe. The production of manufactured wares to send to the gold countries, and to avail of the local demand for goods, required more raw material, at a moment when the short harvests and war enterprise enhanced general wants. The effect of these was equivalent to a large transfer of capital to the west, not only from Europe, but also from those eastern states that are usually buyers of food. Thus the wheat crop of the United States in 1850, by census, was equal to 22,000,000 bbls of flour. The average export price in that year was $5, giving to the crop a value of $110,000,000. In 1855, the average price was $10, giving a value of $110,000,000 greater. This sum was taken out of the pockets of the food buyers, to the profit of the food sellers, at the moment when the latter were enjoying so large an expenditure for other purposes. The exports of agricultural products rose from $24,309,210, in 1850, to $77,686,455, in 1856. The great activity of the years ending with 1857 was, then, due to heavy expenditure of capital at the west simultaneously with profitable sales of its crops. The panic of that year caused not only a total cessation of the expenditure, but an earnest desire to recover capital invested at the west. Railroad building stopped, migration ceased, speculation was at an end, and European crops being good, prices of produce fell in face of very poor western harvests. There was no exhaustion of capital, since it was apparently more abundant and cheaper at the great eastern reservoirs than ever before; but the stimulus to its employment was gone, and it accumulated in first hands. The broad lands of the west had filled up to some extent, with industrious inhabitants: they were supplied with sufficient means of communication for their needs, at that time; and when the wheels of commerce should be again set in motion they were ready to respond with abundant crops.

If we bring together by recapitulation the aggregates of the seven decades since the formation of the government, we shall have a very interesting synopsis of the national progress in respect of commerce. The treasury department has also caused to be prepared, with great care, the annual value of agricultural products and manufacturing industry at corresponding periods. If we add them to the table, it will be so much the more complete, as follows:—

| | Exports for periods of ten years. Domestic. | Foreign. | Total. | Imports. | Manufactures. Annual value. | Agriculture. Annual value. |
|---|---|---|---|---|---|---|
| 1800, | $293,634,645 | $191,344,293 | $484,968,938 | $591,845,454 | .. | .. |
| 1810, | 383,401,077 | 372,536,294 | 755,937,371 | 927.663,500 | $145,385,906 | .. |
| 1820, | 462,701,288 | 127,190,714 | 589,892,002 | 688,120,347 | 62,766,385 | .. |
| 1830, | 536,104,918 | 229,643,834 | 765,748,752 | 798,633,427 | 111,645,466 | .. |
| 1840, | 892,889,909 | 199,451,994 | 1,092,351,903 | 1,302,476,084 | 483,278,215 | $621,163,977 |
| 1850, | 1,131,458,801 | 129,105.782 | 1,260,564,583 | 1,267,783,782 | 1,055,595,899 | 994,093,842 |
| 1860, | 2,745,109,155 | 228,883,058 | 2,983,872,213 | 2,922,159,539 | 1,886,000,000 | 2,000,000,000 |
| | $6,445,299,793 | $1,478,155,969 | $7,933,336,662 | $8,498,682,133 | 3,744,671,871 | $3,615,257,819 |

This table, mostly official, gives the extraordinary results of a nation's industry and commerce in a period of seventy years. The growth has such an accumulative force, as to be very surprising. In the item of re-exports of foreign goods, the trade never recovered the figures they touched at the period when American vessels did the carrying trade for fighting Europe. In the period 1855–1860, however, under the warehouse system of the United States, and the reciprocity treaty with the British provinces, some increase in that respect took place, the more so that steam and extended relations opened to the United States a larger share of the South American trade, tending ultimately to give the United States the preponderating influence. The exports of domestic goods grew rapidly under the more extended demand for cotton throughout the world, and of which the United States was the only source of supply. All other cotton countries, India particularly, required more cotton in the shape of goods than they supply in the raw state. The demands for cotton clothing increase in the double ratio of greater numbers and greater wealth throughout the world. Cotton is, however, not the only article which increases in export value. The tables show us that gold figured in ten years for $495,000,000 as an article of export, and may not be less in future decades. The agricultural resources of this country have just begun to be developed. Up to 1842 there was, under the restrictive systems of Europe, comparatively no market for American farm produce. In that year the statesmen of England recognized the fact that the demands of English workpeople for food had outgrown the ability of the British islands to supply it on terms as low as it could be bought elsewhere. They therefore removed the prohibition upon the import of cattle and provisions, and reduced the duty on grain. This opened a market for American produce, which grew rapidly. The circumstances of the famine of 1846 justified the wisdom of the English government, and led to the entire removal of the corn duties in 1849. That example was followed by France and her neighbors. France, however, restored the duties in 1859. The liberal legislation of England, the famine, the wars, and speculations of Europe, have gradually extended the demand for American produce, at the time when a very broad field had been opened to supply that demand. This we may illustrate. The area of Great Britain's industry—hills, lakes, vales, and valleys—is 53,760,000 acres; and the population in 1812, when she made war on us, was 11,991,107. Now we find from the table of land sales, elsewhere given, that the federal government had sold in twenty years selected farm lands to the extent of 68,655,203 acres, and had given to railroads 42,000,000 acres more of selected lands, making 110,000,000 acres, most of which passed into the hands of settlers. This is a surface double the whole area of Great Britain; and the population on that area increased, in the same time, to 11,374,595, or a number nearly as large as that of Great Britain in 1812. There were built on that area, between 1850 and 1860, and are still in operation, 20,000 miles of railroads, crossing every part of it, and bringing most of the farms within reach of a market. The speculators and road builders, who ate up the produce of that area, during the process of road construction, vanished, and the whole was offered by a hundred channels to the best bidders of Europe. We have said that corn is the settler's capital, and that corn, in the shape of grain, pork, and whiskey, is the staple export of a new country. The corn product of 1855, per state reports, was 600,000,000 bushels. The number of hogs packed that year was 2,489,050, averaging 200 lbs. each, and giving a total weight of 497,900,000 lbs. of pork. In that year the weight of pork exported was 164,374,681 lbs. Of this amount, 58,526,683 lbs. went to England, or 12 per cent. of the whole production, as the result of her more liberal policy of 1842.

QUANTITIES OF CORN AND PORK EXPORTED TO GREAT BRITAIN.

| | Pork, barrels. | Hams and Bacon, lbs. | Lard, lbs. | Corn, bushels. | Wheat, bushels. | Flour, barrels. |
|---|---|---|---|---|---|---|
| 1840, | .... | 1,061 | .... | 104,341 | 615,972 | 620,919 |
| 1841, | 4,769 | 26,394 | 444,305 | 12,548 | 119,854 | 208,984 |
| 1849, | 111,385 | 53,150,465 | 21,388,265 | 12,392,242 | 608,661 | 953,815 |
| 1860, | 91,640 | 19,447,163 | 18,866,178 | 3.726,786 | 699,713 | 1,926,202 |
| 1862, | 48,010 | 155,462,500 | 62,325,300 | 5,776,772 | 18,564,756 | 2,971,918 |
| 1869, | 105,210 | 82,901,728 | 28,667,968 | 32,986,804 | 24,538,646 | 977,714 |
| 1872, | 285,847 | 246,208,143 | 191,651,660 | 34,491,650 | 26,423,080 | 2,514,535 |
| 1874, | 352,412 | 347,405,405 | 205,527,471 | 34,434,606 | 71,039.928 | 4,094,094 |
| 1877, | 348,360 | 460,057,146 | 234,741,233 | 70,860,983 | 40,325,611 | 3,343,665 |
| 1879, | 422,009 | 732,249,576 | 326,658,686 | 86,296,252 | 122,353,936 | 5,629,714 |
| 1880, | 479,749 | 759,773,109 | 374,979,286 | 98,169,877 | 153,752,795 | 6,011,419 |

The cotton, tobacco, and rice of the south, the farm produce of the west, and the gold of California, each contributed an increasing proportion to the general exports; but manufactures have also come to figure largely in the general aggregate.

The following table gives the proportions in which the general heads of exports have contributed from time to time to the result, since the formation of the government; and also the total exports, including all articles:—

HEADS OF EXPORTS.

| | Cotton. | Tobacco and Rice. | Flour and Provisions. | Manufactures. | United States Specie. | Total of all Domestic Exports. |
|---|---|---|---|---|---|---|
| 1790, | $42,285 | $6,103,363 | $5,991,171 | .... | .... | $19,666,000 |
| 1803, | 7,920,000 | 8,664,000 | 15,050,000 | $2,000,000 | .... | 42,205,961 |
| 1807, | 14.232,000 | 7,783,000 | 15,706,000 | 2,309,000 | .... | 48,699,592 |
| 1816, | 24,106,000 | 15,187,880 | 20,587,376 | 2,331,000 | .... | 64,781,896 |
| 1831, | 31,724,682 | 6,908,655 | 12,424,701 | 5,086.890 | 9,014,931 | 61,277,057 |
| 1836, | 71,284,925 | 12,607,390 | 9,588,359 | 6,107,528 | 345,738 | 106,916,680 |
| 1847, | 53,415,848 | 10,848,982 | 68,701,921 | 10,351,364 | 2,620 | 150,637,464 |
| 1851, | 112,315,317 | 11,390,148 | 21,948,651 | 20,136,967 | 18,069,580 | 196,689,718 |
| 1860, | 191,806,555 | 18,473,946 | 43,767,922 | 39,803,080 | 56,946,851 | 373,189,274 |
| 1864, | 1,180,113 | 12,482,255 | 133,021,299 | 27,171,017 | 75,804,747 | 320,035,199 |
| 1868, | 152,820,733 | 26,169,264 | 102,245,023 | .... | 70,841,396 | 454,301,713 |
| 1870, | 227,027,624 | 22,832,880 | 101,426,472 | 93,313,456 | 58,155,666 | 499,092,143 |
| 1874, | 211,223,580 | 32,995,603 | 239,527,854 | 135,444,501 | 66,630,405 | 693,039,054 |
| 1878, | 180,031,484 | 28,518,435 | 305,342,043 | 162,403,158 | 33,740,125 | 722,811,815 |
| 1880, | 211,535,905 | 18,455,639 | 415,080,077 | 148,085,171 | 17,142,919 | 833,294,246 |

These general heads represent all parts of the Union—cotton and tobacco in the south, flour and provisions in the west, manufactures in the east, and gold in the Pacific states. For many years previous to 1861, there had been a steady increase in the demand for cotton and tobacco from Great Britain and France, and cotton, especially, had come to be so important an item of our exports and of European import, that the statesmen of Great Britain had become alarmed, and had made great efforts to stimulate the production of cotton in India, Egypt, and elsewhere, that they might be less dependent upon the United States for so necessary a product. These efforts had not been attended with great success. A considerable quantity of cotton was indeed grown in India, but it was of so shorta staple that it would not make strong anddurable goods; and the natives of India required a constantly increasing quantity of machine made cotton goods, which it was thought could only be made from American cotton. Our cotton growers, therefore, felt confident that their market for all the cotton they could raise was a permanent one, and that the price would constantly advance. But the war of 1861–65 materially changed the face of affairs. As we have seen, our exports of cotton fell off, and from approaching 200 million dollars in yearly value, in 1862 they were only $1,180,113. The cotton of India improved in quality, and, though not so good as American, took its place largely. In 1859, 192,330,880 pounds were imported from India into Great Britain, at a cost of about 15 million dollars. In 1866, the import from India was 654,106,686 pounds, valued at about 88 million dollars. When the south recovered itself so as again to raise large crops of cotton, European customers were found ready to buy all she had to sell, though they still used Egyptian and Indian cotton to some extent; but American cotton is better, and the exports of that crop since 1870 have largely exceeded both in amount and value those of 1860–61, while the crop itself has been a million and a half bales greater than that of that year. Still it is not as exclusive a crop in the south as it was before the war. It was formerly believed that Europe would not require any great quantity of food supplies from us except in years of very bad harvests; but the increase of manufacturing and decrease of the supplies of grain from the Black Sea, have rendered Western Europe permanently dependent upon us for breadstuffs and provisions, and were not our country so vast and our climate so varied that our crops do not fail in all sections at once, there might be reason for apprehension, that with our rapidly increasing home demand a short crop might cause famine in Europe.

The column of manufactures produced is not brought down beyond 1860, but we give below the estimated amount for 1880. The quantity and values of manufactures exported is brought down to 1880 and shows a most rapid increase. If we included in this statement the flour and meal, the hams and bacon, the butter, cheese, lard and canned and preserved meats and vegetables, all of them properly manufactured products, but included in that table as flour and provisions, the annual export of manufactures would be not less than 300 millions of dollars.

In order to manufacture to advantage, something besides a law is necessary. There must be capital and a supply of skilled labor. Those, in the long race of a thousand years, grew up in England, where the system of manufactures is mostly individual. A man learns his trade and devotes himself to the production of an article, or a part of an article, and by the constant exercise of intelligence and economy, he comes finally to perfect it in the cheapest manner. These productions are combined by other parties into merchantable commodities. In the United States it was a consequence of the prohibition under the imperial government, that these individual industries did not grow up. There were no factories in which young artisans were learning a business, and when separation took place there was no experienced labor. When, therefore, the capital that had been earned in commerce was suddenly applied to manufactures, the only mode of proceeding was the corporate mode; the capital was subscribed by a company, and the works directed by persons often of little practical experience. Under such a system, progress was difficult. With the large immigration of skilled workmen from abroad, however, a greater breadth has been given to all branches, and progress is very rapid, the more so that the general prosperity enables consumers to extend the best possible encouragement to producers, by buying their wares. The chief consumers of these have been the agriculturists, and the interchange of manufactures for agriculture forms the chief trade of the whole country. In 1840, per census reports, the value of manufactures was $483,278,215, and of agriculture, $621,163,977; the imports were $107,000,000. The interchange of these commodities, at first hands, would involve an aggregate trade of $1,211,442,192. The same items for 1860 would give an aggregate of $4,830,000,000—four times the amount. But the raw material passes through many hands before it reaches the manufacturer, and his wares pass through a succession of merchants, jobbers, and retailers before they are finally consumed. Grain passes through many hands before it is finally eaten. The grinding of flour is one of the largest manufactures of the country, turning out in 1860, $248,580,365 per annum. It is probable that each of the articles which form the aggregate of the mining, manufactures, agriculture, and imports, is sold four or five times before it is finally consumed. This would give an aggregate trade of $25,000,000,000 per annum, in 1860, against $6,000,000,000 in 1840, or an average of $3,300 per annum for every effective man in the country. This seems very large. If, however, we have recourse to the circular of the leading mercantile agency in New York, whose ramifications extend over the Union, we find they report upon their books, 250,000 firms in business in 1857—the panic year; of these firms in business 4,932 failed in 1857, for an aggregate of $291,750,000 of liabilities, or an average of $58,350 each. If the average of all the persons doing business was only $50,000, or $8,350 each less than those who failed, then the aggregate amount of credits must have been $12,500,000,000 in 1857. The firms on the books do not include many retailers. Of course the credits of the retailers added to these, and the greatly larger volume of trade in 1860, would more than double these figures. Again, the bank discounts for the year 1860 were $637,183,899; these purport to represent bills not more than sixty days to run. The average of some of the largest city banks is 54 days; at 60 days the amount of discounts for a year would be in round numbers, $4,000,000,000; and the exchanges at the New York clearing house, as we see in another chapter were over $8,000,000,000 per annum.* These figures gives some idea of the vastness of that immense traffic, which consists in the interchange of the products of industry. In 1840, the active bank loans were $278,000,000, which, at the same average time, would give $1,668,000,000 of discounts for the year, which holds about the same. In 1850, the loans were $413,756,759, which would give an aggregate discount for the year of $2,484,000,000. Comparing these aggregates for several years, we have results as follows:—

| Years. | Annual Productions. | Annual Transactions. | Bank Discounts. |
|---|---|---|---|
| 1840 | $1,211,442.192 | $6,055,000,000 | $1,668,000,000 |
| 1850 | 2,305,343,446 | 11,525.000,000 | 2,484,000,000 |
| 1860 | 4,830,500,000 | 24,152,5 0,000 | 3,943.003,000 |
| 1870 | 6,843,559,616 | 45,813,300,000 | 8,576.338,824 |
| 1880 | 10,610,253,148 | 67,474,100,000 | 10,247,533,926 |

We have, then, the fact that the national trade doubled in the ten years ending with 1850, as a consequence of the increased productions of industry; and the best data give the same general results for the decades from 1850 to 1880. These large figures, astonishing as they seem, are not out of proportion to the immense growth of the country in breadth and numbers.

The thirteen colonies that emerged from a war, ninety years since, have grown to be thirty-eight states, with a land value of, in round numbers, $16,160,000,000. All this vast territory is now productive, yielding its annual returns, and giving an amount of annual capital beyond any thing the world has hitherto witnessed.

The following table gives the states and territories in the order of their admission to the Union, or organization, their area in acres, population in 1790, and population and valuation of each state in 1850, 1860, 1870, and 1880. The new states and territories have made great strides in population and valuation since 1860.

*In 1880 these exchanges exceeded $40,000,000,000.

## CHAPTER III.

### SHIPS—TONNAGE—NAVIGATION LAWS.

The appearance of the United States as a nation was fraught with the most extraordinary results in respect to the condition, policy, and governments of Europe, but in none greater than in respect of navigation. From the moment that the stars and stripes floated from the mast-head of a merchantman, a revolution was commenced which has not yet ceased its influence upon the commerce of the world. Up to that time, England had gradually attained the supremacy of the seas. The Dutch, who had fought a steady battle with the ocean, until they had driven it back and fortified their country by dykes from its invasion, had earned a right to rule; which, by their energy, they did for a time. Their country was small, however, and produced but little: hence, they could not support commerce in the face of the power of England. The United Kingdom has great productive power, though its area is only 2½ times that of Pennsylvania. Its coast is indented on all sides with harbors; and from which side soever the wind blows, it is fair for some of her vessels to arrive, and others to depart. A sea-girt population is necessarily a nautical population. The English were peculiarly fitted for sea adventure; and with such advantages, added to their skill in building, they could not fail to acquire ascendancy upon the ocean, which their large population maintained and fed by planting colonies in all parts of the world. When the commerce of England had well grown, as a consequence of these advantages, her government, in the hands of Cromwell, sought to increase it by enacting the famous "navigation law," which was popular, because it professed to give England the supremacy of the ocean. The principle of the law was, that no goods should be imported into England from Asia, Africa, or America, except in British vessels; that goods imported from Europe in European vessels should pay more than if imported in British vessels. This was very plausible. It would, it was supposed, give England the world's commerce; but as there then existed none but British vessels in either of the three continents out of Europe, there was no more trade, in consequence of the law, than before. The law was a dead letter. The growth of English commerce was evidently great. The statesmen of Europe ascribed it rather to the law than to the circumstances of the people, and they imitated its provisions. The trade between England and her colonies was large, but the vessels were all British. The development of this industry of the North American colonies, and their trade, was probably the first real opposition on the ocean that the Dutch received. So much did it flourish in the seventeenth century, that Sir Joshua Childs, writing in 1670, states that "Our American plantations employ nearly two-thirds of our English shipping, and thereby give constant subsistence to, it may be, 200,000 persons here at home." Ship-building had been pursued with great success in the colonies; and the genius of the colonists had already given their ships a distinctive character. On the declaration of peace, in 1783, that "bit of striped bunting" was found floating at the gaff of all the best vessels. They, by the law, could now carry no goods to England. The large exports of the United States were now to go in the worst vessels, because they were English. The United States immediately passed a similar law, that forbade any goods to be imported, except in American vessels. The American vessel then went out in ballast to bring home English goods, and the English vessel came out in ballast to carry home American produce. Two ships were employed to do the work of one, and all imports and exports were charged two freights. This was too absurd, even for statesmen. A treaty was consequently made, by which the vessels of both nations were placed upon the same footing. The practical effect of this was to double the quantity of tonnage employed, since the vessels of both nations could now carry freights both ways. The position of affairs was, however, entirely new. The United States—a young country, with few ships and less capital, distributed among a sparse population—presented itself to the old, wealthy, and aristocratic governments of Europe, and demanded of them that they should admit its ships to visit their populous and wealthy cities, in return for the privilege of their visiting the comparatively poor and unattractive towns of the states. This kind of reciprocal intercourse had never existed; and the United States now came forward to propose it, and to lay down principles for its guidance. Their moral influence caused them to be adopted. These principles were, "independence," "equal favor," and "reciprocity." These principles were first laid down in the treaty made between France and the United States in 1778, and they became the basis of all subsequent negotiations. The commercial sagacity of the English prompted them to accede at once. The United States vessels were accordingly placed upon the footing of the "most favored nation." From the moment the United States entered that wedge, the whole system of exclusiveness began to fall to pieces. There are now forty-eight treaties between the United States and other countries, most of them containing the favored nation clause. The benefits of this example have been so fruitful, that all the nations of Europe have eaten through their old restrictive systems, by similar treaties with each other. Although England was forced into this concession in her direct trade, she, for a long time, refused it in respect of her colonies. It was reserved for a later period to force her into that movement. The vessels of the United States having thus gained an international footing, events supervened to give a great impulse to their employment in the carrying trade. In colonial times, Massachusetts Bay was the chief theatre for ship-building, but Maryland was also noted for it. The vessels built in 1771 were as follows:—

AN ACCOUNT OF THE NUMBER AND TONNAGE OF VESSELS BUILT IN THE SEVERAL PROVINCES IN THE YEAR 1771.

| | Square-rigged vessels. | Sloops and schooners. | Tonnage. |
|---|---|---|---|
| New Hampshire | 15 | 40 | 4,991 |
| Massachusetts Bay | 42 | 83 | 7,704 |
| Rhode Island | 15 | 60 | 2,148 |
| Connecticut | 7 | 39 | 1,483 |
| New York | 9 | 28 | 1,698 |
| New Jersey | | 2 | 70 |
| Pennsylvania | 15 | 6 | 1,307 |
| Maryland | 10 | 8 | 1,645 |
| Virginia | 10 | 9 | 1,678 |
| North Carolina | | 8 | 241 |
| South Carolina | 3 | 4 | 560 |
| Georgia | 2 | 4 | 543 |
| Total | 128 | 291 | 24,068 |

The tonnage entered and cleared for the year 1771, to all ports, was as follows:—

| | Cleared from colonies. | Entered colonies. |
|---|---|---|
| Great Britain | 98,025 | 82,934 |
| Southern Europe | 37,237 | 37,717 |
| West Indies | 108,150 | 106,713 |
| South and Central America | 107,552 | 104,578 |
| | 350,964 | 331,942 |

This was before the war. After the war, the trade received a great development from the French treaty of 1778, and from that with Great Britain. The ship-building during the colonial period had been in very different styles, so that every seaman, at a glance, could recognize the origin of the vessel. The Baltimore clipper, the Essex fishing schooner, the Chesapeake schooner, the down east lumber schooner, or brig, the Hudson river sloop, the Long Island sloop, the Newport boat, the Massachusetts Bay dory, were distinct types, and still preserve their styles to some extent, although the march of improvement has tended to assimilate all styles, by combining their good points. The changes of trade have varied the demand, and since California has brought clippers in demand, they are now by no means a Baltimore peculiarity. The fishing vessels were peculiarly adapted to their employment. The fisheries were the chief business of the northern colonists, and they had not only the benefit of the large sale to the West Indies and to the Catholic countries of Europe, but the eating of fish in England had, by the law of Elizabeth, in 1563, been ordered on Wednesdays and Saturdays, for the encouragement of seamen, thus affording a large market, from which foreign fish were excluded. The same law became a custom down to our day, it being still almost universal in New England to eat fish on Saturday. Indeed, so strictly was this custom observed, that in the old slave days of Massachusetts, it being ordered that slaves should not be in the streets on Sunday, a black was arrested on the common. He denied tha it was Sunday, and proved his point by showing that "massa no eat salt fish yesterday." The fisheries were thought to be the nursery of seamen, and when the Union was formed, a law of July 4, 1789, allowed a drawback on fish exported equal to the supposed quantity of salt used. This law, in 1792, was changed to a bounty per ton on the vessels engaged in the fisheries, and has been continued down to the present time. The number of tons now in the cod fisheries is 79,885. The bounty was paid to this interest until the change in the tariff in 1864, when it was exchanged for a drawback on the duty upon all salt used in curing the fish. The difficulty with the Dominion in regard to the fisheries has rendered this fishery less profitable. The whale fishery seemed peculiarly adapted to the skill and daring of the American seamen. The whale boats were of a peculiar build, and gradually, although they received no protection from the government, they drove away other nations from the seas. The interest is, however, depressed, from the growing scarcity of whales, and the great competition that its product receives from other sources. The making of lard oil brought "prairie whales" into effectual competition with those of the ocean.

The tonnage engaged in the foreign trade increased up to 1810 very rapidly under the influence of the carrying enjoyed under the treaties with Europe, and the effect of the wars between the great powers. The coasting trade did not increase in the same ratio, for the reason that the trade enjoyed by the registered tonnage was not the carrying of American goods, but of foreign products from colonies to Europe. The comparative increase of the tonnage is seen as follows:—

TONNAGE OF UNITED STATES.

| Years. | Foreign Trade, Registered. | Coasting Trade, Enrolled and Licensed. | Whaling Trade, Regist'd and Enrolled. | Cod Fisheries, Enrolled and Licensed. | Mackerel Fisheries, Enrolled. | Steam Vessels. | | Total Tonnage Merchant Marine. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Ocean. | Coasting. | |
| 1789 | 123,893 | 68,607 | ... .... | 9,062 | . . .... | ........ | ... .... | 201,562 |
| 1810 | 981,019 | 405,347 | 3.589 | 34,828 | ........ | ........ | ... .... | 1,424.783 |
| 1821 | 593,825 | 614,845 | 27,995 | 62,293 | ........ | .. ..... | ........ | 1,298,958 |
| 1829 | 592,859 | 508,858 | 57,284 | 101,797 | ........ | ........ | ........ | 1,260.798 |
| 1840 | 762,838 | 1,176,694 | 136,927 | 76.036 | 28,269 | 4,155 | 198,184 | 2,180,764 |
| 1850 | 1,439,694 | 1,797,825 | 146,017 | 93,806 | 58,112 | 44,952 | 481,005 | 3,535,454 |
| 1858 | 2,301,148 | 2,401,220 | 198,594 | 119,252 | 29,594 | 78,027 | 651.363 | 5,049,808 |
| 1863 | 1,926.886 | 2.960.633 | 99,228 | 117.290 | 51,019 | 133,215 | 442,304 | 5,155.056 |
| 1868 | 1,494,389 | 2,702,140 | 71,343 | 83,887 | ........ | 221,939 | 975,142 | 4.351,759 |
| 1870 | 1,448,846 | 2,638,247 | 67,954 | 91,460 | ........ | 192,544 | 882,551 | 4,246,507 |
| 1875 | 1,515.598 | 3,219 698 | 38,229 | 80,207 | . ...... | 191,689 | 976,979 | 4,853.732 |
| 1880 | 1,314.402 | 2,637.686 | 38.408 | 77,539 | ........ | 199,876 | 1,011,683 | 4.068.035 |

This table gives a sort of chart of the whole progress of the tonnage. It is observable that up to the close of the first period, viz.: to the embargo and non-intercourse of 1809, the registered tonnage, or that engaged in the foreign trade, increased most rapidly; there were then no large home productions to require much inland transportation, and the carrying trade of Europe was very active. With the growth of cotton, however, an immense freight was given as well to coasting as to registered tonnage, and that was far more valuable to the latter than the carrying trade which had been lost. When the war and non-intercourse stopped the growth of external tonnage, a great impulse was given to that of the interior. The lakes and rivers began to be covered with craft, which swelled the enrolled tonnage. In the south a good portion of this tonnage was employed in the transportation of cotton to the seaboard, where it was freighted to Europe in registered vessels. The operation of the laws in relation to the measuring of vessels had an injurious influence upon the form. The making the beam of the vessel an element in the calculation of the tonnage she would carry, led to the construction of "kettle bottoms," which swelled out in the form of a kettle, allowing her to carry much more than her register showed. These vessels carried cotton mostly to European ports, whence there was little return cargo; but when, after the war, migration set in freely from Havre, affording a return freight, the form was altered to give accommodation to the passengers, and an impulse was given to ship-building. The latter branch of industry languished up to 1829, since there was little carrying trade, and the cotton crop was only one-sixth its present quantity. The British government had refused to allow the West India colonies to be open to American vessels. The West Indies, however, were dependent upon the United States for supplies of produce, while they were required to send their own sugar, coffee, and rum to the mother country in British vessels. By refusing to let American vessels go thither, she sought to secure three freights for British ships. Thus, a vessel left England with goods for the United States, then loaded provisions for the West Indies, and took home thence sugar, etc., to England, making a round voyage. This the United States refused to permit, unless American vessels participated; and the trade was closed. The English colonists, deprived of American supplies, set up a clamor which compelled the government to open certain ports to American ships on the same terms as British ships; and Congress, in return, authorized the President, by proclamation, to open United States ports to colonial vessels, whenever he should have proof of a reciprocal movement. This took place in 1830, and the trade has rapidly increased since.

The increase of registered tonnage, as of all others, had been large up to 1840, under the general animation that trade encountered from the speculative action of those years. Two circumstances now, however, occurred to enhance the demand for shipping. These were the English-China war, and the American-Mexican war. The attempts of the English to force the opium trade upon the

Chinese, contrary to their laws, had induced the Chinese, in 1841, to destroy a large quantity of opium. This brought on the war which resulted in the opening of five Chinese ports to the commerce of the world, and by so doing increased the demand for American ships — always favorites with the merchants in the trade between India and China. One result of the English war with the Chinese was the negotiation of a treaty of a very favorable nature between the United States and the Chinese government. The Americans and English had long traded together, and their nationality had long been a puzzle to John Chinaman. As far as he could see, they both spoke the same language, although they sailed under different flags; but, with his natural acuteness, he had observed that the "red-haired devils" had more capital than the Americans; he consequently classified the latter as "second-chop Englishmen." He was now, however, not sorry to give them the advantage in the treaty negotiated by Hon. Caleb Cushing, or, as they styled him, Ku-ching. The return of that minister to the United States across Mexico was attended with a new insult from that people, who robbed him of his baggage. Subsequently, the long train of insults heaped upon Americans through the recklessness and arrogance of the Mexicans, ended in a war in 1846. That event caused a large demand for shipping on the part of the government, for transports. The expedition fitted out under General Scott for Vera Cruz, was the largest naval enterprise ever undertaken by any nation up to that time — that is, a like number of troops had never before been transported so great a distance by sea to open a campaign in an enemy's country The American expedition was promptly successful. Following these two events, that absorbed so much shipping, came the Irish famine. The same famine, which created the extended demand for American produce, also stimulated a large migration to the United States, furnishing ample freights to the homeward-bound shipping.

The increase of steam tonnage was the most remarkable. The first arrival of a steamer from England was the Sirius, April 23, 1838. That experiment was looked upon with distrust, but it has succeeded so far, that thirty-three lines, running one hundred and ninety-six ships, have been started between the United States and Europe. In July, 1840, the Brittania, the Cunard boat, arrived at Boston; and that line has continued to be almost uniformly successful up to the present time. The lines since started are as follows, mostly running from N. Y.:—

STEAMSHIP LINES BETWEEN THE UNITED STATES AND EUROPE SINCE 1840.

| LINE. | From What Port. | To What Port or Ports. | Style. | Ownership. | No. of Ves'ls. | Aggregate Tonnage. |
|---|---|---|---|---|---|---|
| Cunard Line, | N. Y., | Liverpool, | Screw, | British, | 10 | abt. 33,000 |
| Cunard Line, | Boston, | Liverpool, | Screw, | British, | 5 | abt. 16,000 |
| *Collins Line, | N. Y., | Liverpool, | Paddle wheel, | American, | 3 | 9,727 |
| *Scotch Line, | N. Y., | Glasgow, | Screw, | British, | 3 | 6,612 |
| *Irish Line, | N. Y., | Cork. | Screw, | British, | 2 | 2,000 |
| General Transatlantic, | N. Y., | Havre and Marseilles, | Screw, | French, | 10 | abt. 38,000 |
| ?French or Pereire Line, | N. Y., | Havre, | Screw, | French, | 6 | abt. 15,000 |
| *Old Havre Line, | N. Y., | Havre, | Paddle wheel, | American, | 3 | 7,200 |
| *Vanderbilt Line, | N. Y., | Havre, | Paddle wheel. | American, | 3 | 7,600 |
| *Independent Line, | N. Y., | Havre, | Paddle wheel, | American, | 1 | 1,800 |
| Red Star Line, | N. Y., | Antwerp, | Screw, | Belgian, | 6 | . . . |
| *Bremen Line, | N. Y., | Bremen, | Paddle wheel, | American, | 2 | 4,000 |
| *Hamburg Line, | N. Y., | Hamburg, | Screw, | German, | 2 | 2,400 |
| *Philadelphia, | Phila., | Liverpool, | Screw, | British, | 3 | 6,856 |
| *Portland, | Portland, | Liverpool, | Screw, | British, | 2 | 3,000 |
| *North Atlantic, | N. Y., | Southampton, | Paddle wheel, | American, | 5 | 16,000 |
| *Liverp'l & Gt. West'n, | N. Y., | Liverpool, | Screw, | British, | 10 | 30,600 |
| Inman Line, | N. Y., | Liverpool, | Screw, | British, | 10 | 36,000 |
| National Line, | N. Y., | Liverpool and London, | Screw, | British, | 12 | 40,000 |
| White Star Line, | N. Y., | Liverpool, | Screw, | British, | 8 | 33,000 |
| Guion Line, | N. Y., | Liverpool, | Screw, | British, | 6 | 25,600 |
| North German Lloyds, | N. Y., | Bremen, | Screw, | German, | 7 | 24,600 |
| Anchor Line, | N. Y., | Glas., Lon., and Barrow, | Screw, | British, | 18 | 77,000 |
| Hamburg American, | N. Y., | Plym'th, Lon., and Ham., | Screw, | German, | 9 | 27,000 |
| State Line, | N. Y., | Glasgow, Liverpool, &c., | Screw, | British, | 6 | 18,000 |
| Monarch Line, | N. Y., | London, | Screw, | British, | 5 | 19,200 |
| Phila., New Line, | Phila., | Antwerp, | Screw, | Netherlands, | 3 | 9,000 |
| Penn. State Line, | Phila., | Liverpool, | Screw, | American, | 3 | 10,500 |
| Rotterdam Line, | N. Y., | Rotterdam, | Screw, | Netherlands, | 5 | 16,000 |
| Great Western Line, | N. Y., | Bristol and Cardiff, | Screw, | British, | 5 | 15,000 |
| Miss. & Dom. Line, | N. Orleans, | Montreal and Liverpool, | Screw, | Am. and Can., | 10 | 22,000 |
| Allan Line, | Bos. & Que. | Liverpool, | Screw, | Am. and Can., | 10 | 33,000 |
| Med. & N. Y. Line, | N. Y., | Mediterranean Ports, | Screw, | British? | 3 | 7,500 |

*These lines have been discontinued. Twenty lines, with 140 ships, only three of them American, are now engaged in this traffic, and all are now fully employed.

It is very difficult to estimate the number of passengers who have crossed the Atlantic on these steamers since 1840. At first, and until there were regular lines established, there were many who preferred the clipper packet ships, and at the end of the first twenty years, 1840–1860, it was thought that the whole number of passengers either outward or homeward bound did not exceed 500,000. After the civil war, the number of lines rapidly increased, though, we are sorry to say, there were very few American vessels among them. Business men were constantly crossing the ocean, either for business or recreation; many thousands desired to see Europe and the east, and the international expositions drew additional thousands. Every steamer carried and brought all the passengers for whom it had accommodations, and new lines were called for. Some of these undertook to bring immigrants as steerage passengers; these had heretofore come only by sailing vessels, but when the steamships undertook this additional service, they soon built large vessels and almost every ship became a floating city. Before 1870, it was estimated that more than 1,500,000 passengers had made the passage of the Atlantic by them. With the vast outgoing tide of travelers and tourists, and the still vast incoming flood of immigrants, five or six thousand landing in a day, and 600,000 in a year from these steamers, at the port of New York alone, the aggregate to July 1881, cannot be less than 6,500,000.

In such an immense passenger traffic there have been, of course, some disasters and loss of life; but the percentage has been very small, the loss of life from disasters in the whole 40 years being a little less than 5,000, or about one person in every 1,300, so that, as "Mark Twain" says, "the voyage is safer than remaining at home; the chance of dying in your bed at home being greater than that of dying by accident to the steamer." These 5,000 deaths include, however, only those occurring from loss of the steamer; not those from personal accidents, suicide, or sickness, either previously existing, or contracted on the vessel. But the percentage of these is not large.

But our ocean steamship service is not confined to the lines from our Atlantic ports to Europe. We have also steamers of large capacity plying to Richmond, Charleston, Savannah, and New Orleans, to the West India ports, and especially to Havana, to Galveston, Indianola, Vera Cruz, Aspinwall, and Nicaragua. On the Pacific coast, there are the lines of the Pacific Mail Co.; the steamships to Japan, Hong Kong, the Sandwich Islands, and Australia, and those plying northward to the Columbia River, Puget Sound, British Columbia, and Alaska.

The growth of steam service in the interior of the country was more rapid than its external development. The amount of steam tonnage in ocean navigation, in 1850, was 44,942, against none in 1840. The inland tonnage engaged on lakes, rivers, and coasting, was 481,004—an increase of 283,000 in ten years, at a cost of $28,-000,000.

When the western country, with its fertile fields and magnificent water-courses, attracted settlers, and these had produce for sale, there was but one way to market, and flat-bottom boats, launched upon the descending streams, bore the freights to New Orleans. At that point they were not unfrequently broken up, the owners returning by land. In 1794, two *keel* boats sailed from Cincinnati to Pittsburg, making the trip in four weeks. Each boat was covered, so as to be rifle-proof; was loop-holed for muskets, and six guns, to carry pound balls. It was in this manner that persons and property were protected from Indian aggression. The other western rivers presented similar means of travel. Even this was progress, however; and each year saw the numbers and wealth of the dwellers increase. In 1790 the first sea-going brig was built at Marietta, Ohio. She was called the St. Clair, 120 tons, owned and commanded by Commodore Preble, who descended the Ohio and Mississippi, and arrived, *via* Havana, at Philadelphia, where she was sold. In 1802–4, four ships, three brigs, and three schooners, were built at Pittsburg for the Ohio navigation. Keel boats and sea-going vessels rapidly multiplied; but the dangers of the navigation retarded commerce. The dangerous falls of the Ohio were a drawback; and the Kentucky legislature, in 1804, incorporated a company to cut a canal round them. This was, however, not done until 1830. After 1806, the march of commerce and civilization began to make itself felt, and trade was carried on in *keel boats*, which, however comfortable they might float *with the stream*, required three months for a voyage from New Orleans to Cincinnati. The first steamboat on the rivers was built by Fulton at Pittsburg, in 1811. She cost $20,000, and took her first freight and passengers at Natchez, arriving at New Orleans in December. She continued to run three or four years between those points, eight days up and three days down, clearing, the first year, $20,000. Steam tonnage then rapidly multiplied.

The increasing population and traffic growing out of the annexation of Louisiana territory, and the results of the war of 1812, greatly stimulated river navigation and trade. From 1815 to 1840, a period of twenty-five years, there was a complete transformation in the appearance of the Ohio river and its tributaries, and the valley which they watered. Instead of the long stretches of uninhabited lands lying between Pittsburg and Cincinnati, and the mouth of the Ohio, which made the voyage so monotonous to the keel-boatman, the passengers on the hundreds of steamboats saw everywhere on the shores of the "beautiful river," prosperous towns and villages, and penetrating inland, found a numerous and busy population depending on these steamboats for the means of transporting their crops and products to market. The region drained by the Ohio and its tributaries has an area of 142,000 square miles, or 91,000,000 acres.

The computation of those who owned the first steamboat on this river, made after her first trip, is said to have been, that if 6 cents freight could be obtained on each pound,. and *they could get enough to do*, the investment would be a profitable one. The result has shown that freight has been reduced to less than a cent, and that ample employment is afforded for hundreds of boats. The number of steamboats built previous to the year 1835, inclusive, was 588, of which 173 were built at Pittsburg, and 164 at Cincinnati. The number of boats in active business in 1838 was 357, measuring 65,000 tons, or 180 tons each; in 1871 (the Mississippi, Missouri, and Columbia rivers and their tributaries being added), the number of steamers in business on these rivers was 1,017, and their tonnage 272,795; in 1880, the number of vessels was 1,225, and the tonnage 256,916.

The opening of the Erie canal, in 1825, gave a new direction to western produce. The great lakes, from forming a separation from Canada, at once became a means of communication between the inhabitants of the vast circle of their coast and Buffalo, the gateway to the east. Those vast seas form a basin, into which pours from every quarter the produce of eight sovereign states, not including the Canadian side. On these lakes a few craft had floated; and in Erie harbor, in 1812, was built, in seventy days from cutting the timber, that remarkable fleet that bore Perry's flag to victory, and made the lakes American seas. Tonnage multiplied as the produce increased, and the construction of the Ohio canals gave a northern direction to it.

Up to 1820 there was but one steamer on the lakes, and not until 1827 did a steamer reach Lake Michigan. In 1832 a steamboat landed troops at Chicago. In 1833 there were on the lakes eleven boats, which had cost $360,000. They carried 61,480 passengers in that year. In 1840 there were forty-eight boats on the lakes, and their value was $2,200,000. In 1859 the number of boats was 186, and the value $3,997,000, including propellers.

Since the civil war, not only has our merchant marine greatly diminished, much of our vast carrying trade being transported in foreign ships and steamers, owing to the encouragement given by Great Britain to Confederate privateers during the war, but our inland tonnage on the lakes and rivers, which at first increased after the war, has since gradually fallen off, owing to the enormous increase of railroads, which now traverse almost every county of the northern and northwestern states. In 1868 there were 5,365 vessels of all kinds traversing the lakes alone, with a tonnage of 695,604 32 tons; and 2,382 vessels on the western rivers, having a tonnage of 481,218 tons.

In addition to these, there were 19,467 American vessels engaged in the Atlantic and Gulf coast trade, with a measurement of 2,974,975 tons, and 904 of our vessels on the Pacific coast, with a tonnage of 166,512 tons, making a grand total of 28,118 American vessels in the home trade, with an aggregate tonnage of 4,318,310 tons. In 1880 the figures were as follows:

| Sections. | Class. | No. | Tonnage. |
|---|---|---|---|
| Atlantic and Gulf Coasts, | Sailing Vessels, | 14,609 | 1,912,800 |
| | Steam Vessels, | 2,251 | 631,302 |
| | Canal Boats, | 663 | 59,430 |
| | Barges, | 624 | 113,246 |
| | | 18,147 | 2,716,779 |
| Pacific Coast, | Sailing Vessels, | 762 | 148,525 |
| | Steam Vessels, | 310 | 111,295 |
| | Canal Boats, | ... | ...... |
| | Barges, | 71 | 12,541 |
| | | 1,143 | 272,361 |
| Northern Lakes, | Sailing Vessels, | 1,459 | 304,932 |
| | Steam Vessels, | 931 | 212,045 |
| | Canal Boats, | 572 | 47,159 |
| | Barges, | 165 | 40,965 |
| | | 3,127 | 605,102 |
| Western Rivers, | Sailing Vessels, | .... | ...... |
| | Steam Vessels, | 1,225 | 256,916 |
| | Canal Boats, | .... | ...... |
| | Barges, | 1,070 | 216,876 |
| | | 2,295 | 473,792 |
| Grand Total, | | 24,712 | 4,068,035 |

The losses of screw-propellers upon the lakes by wreck and fire, rose from $39,000 in 1848, to $1,159,957 in 1855, and diminished to $91,830 in 1859. The number of vessels lost in ten years was 402, and the value $3,752,131. The number of vessels built in 1880, was 137 on the lakes, 22,899 tons, and 135 on the rivers, 32,791 tons.

Broad canals and numerous railroads are always busy delivering upon the bosom of the lakes the wealth annually created by 18,000,000 of people, and valued at thousands of millions of dollars. The borders of those lakes are dotted with cities, whose marvelous growth has been proportioned to the rapid settlement of the surrounding country. Oswego, Rochester, Buffalo, Cleveland, Sandusky, Toledo, Monroe, Detroit, St. Joseph, Chicago, Milwaukee, Racine, Grand Haven, Sheboygan, Duluth, and many smaller ports, have, like nets, so to speak, accumulated a portion of the vast wealth that has rushed by them over the bosom of the lakes. Each of these cities has a large tonnage employed in the transportation of produce and merchandise; and that tonnage has in the last thirty-five years received a new development by the introduction of the screw-propeller. The invention of Fulton consisted in the adaptation of paddle-wheels to propel vessels. The idea of propelling by a screw in the stern was quite as old as that of the paddle-wheels; it was not, however, successfully constructed until, in 1839, after many failures by others, Ericsson succeeded. A small iron screw-steamer was built and navigated to this country, in 1839, by Capt. Crane, and she became a tug on the Raritan canal. From that time, screws vindicated their value for certain purposes, as superior to paddles. With the improvements which have been made in them within the last twenty-five years, they have driven out the paddle wheels for almost all purposes, being used now exclusively in ocean and lake navigation, and for freight and traction purposes on the rivers. The ferry-boats, and most of the larger river passenger steamers use paddle wheels, but the cost of fuel, and the number of hands employed is much greater. Strenuous efforts are now making to reduce the cost of fuel, and also to utilize the electric force. The form of the screw has undergone continual changes, to obviate some of the difficulties that presented themselves. The model used for many years upon the lakes, was the Loper propeller, invented by Capt. Loper, of Philadelphia. The screw was cast in one piece, and of a form that combines many advantages, particularly that of hoisting out of water with a fair wind. More than twenty years ago, however, a Buffalo invention was introduced, by which the engineer could regulate the "pitch," or angle of the screw blades, according to the circumstances, without taking up the screw. These steam propellers are obviously of a nature to monopolize the trade of the lakes. They make their trips with regularity and promptness. There are now 900 on the lakes, with a tonnage of 205,000. The great progress made in the last twenty years in railroads, which have come to rival canals and rivers throughout the west, and skirting the lakes, has greatly affected the trade in vessels, as well steam as sail. The introduction of steam lessened the amount of tonnage, because steam can perform more voyages. Railroads have again reduced the quantity of tonnage required, because they run all winter, and at all times with greater speed. While this has been taking place, however, greater facilities for getting to sea have made shipbuilding on the lakes more active. Several vessels have been built at the lake ports for Liverpool, going down the St. Lawrence, and some schooners have been built at Cleveland to run between Boston and Albany and Chesapeake bay. Those of about 200 tons cost $10,000. The advantage of building on the lakes consists in the fact that ship plank is much cheaper, say $20 in Cleveland to $60 in Boston, spars $40 against $100; and the vessel makes a handsome freight in lumber on the voyage out.

These circumstances of the increase of the western and lake tonnage, indicate the means by which freights accumulated at the seaports to employ the ocean or registered tonnage, had increased in such rapid proportions in the last nine years. The increase from 1850 to 1858 was, it appears, 637,410 tons, while the sail coasting tonnage actually declined. The discovery of California gold led to the employment of clipper ships for quick passages round the cape, and these, under the pressure of high freights, rapidly multiplied. In 1854, the number of vessels built was 2,024, having a tonnage of 583,450, or a quantity equal to the whole coasting tonnage of the Union in 1830. The tonnage increased too fast, and reaction overtook it. The quantity built in 1859 was only 870 vessels, of 156,602 tons. In ordinary years, cotton is the chief freight of ships, and the ordinary proportion of shipping is as one ton to a bale of cotton produced.

The building under the clipper fever more than doubled from 1851 to 1852. The sales to foreigners have risen to a large item. In the twenty-five years, 1854–79, it amounted to 1,488,075 tons, or 20 per cent. of the whole quantity built. This, at an average of $100 per ton, amounts to $148,807,500, or yearly average sales of $5,952,300, forming a considerable manufacture. The cheapened cost of building on the lakes and western rivers will transfer to that region much of that trade.

The amount of shipping owned in the United States, and engaged in either foreign or domestic commerce, reached its highest point in 1861, viz.: 5,539,813 tons, although it had attained to 5,212,000 tons as early as 1804, but the presence of rebel privateers in the Atlantic, Pacific, and Indian oceans, during the war, and their capture of many merchant ships, led to the sale or transfer of great numbers of vessels to a foreign flag. Since the close of the war there has been more activity in the building and purchase of ships, but at no time since 1865 has the total tonnage reached 5,000,000 tons, the registered tonnage of sailing vessels having fallen off nearly one-half, while the registered steam tonnage has gained moderately, and the enrolled or home tonnage, though fluctuating considerably, has in the average of twenty years gained a little. The following table shows the changes which have taken place, since 1856, in the amount of shipping engaged in our commerce:—

COMPARISON OF AMERICAN AND FOREIGN TONNAGE ENTERING THE PORTS OF THE UNITED STATES, 1856–80.

| YEARS. | AMERICAN. | FOREIGN. | DIFFERENCE. | GRAND TOTALS. |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| 1856 | 3,194,275 | 1,269,763 | +1,924.512 | 4.404.038 |
| 1857 | 3,481,944 | 1,360,983 | +2,120.961 | 4.842.927 |
| 1858 | 3.051,131 | 1,287,102 | +1,764.029 | 4.328,233 |
| 1859 | 3,327.998 | 1.585,033 | +1,742,965 | 4.913.031 |
| 1860 | 3,301.903 | 1,698,291 | +1,603.612 | 5,000,194 |
| 1861 | 3.025,124 | 1,533,963 | +1,491.161 | 4.559.087 |
| 1862 | 2,629.351 | 1,561.945 | +1,067.406 | 4.191.296 |
| 1863 | 2,307,706 | 1,897,714 | + 409.992 | 4.205,420 |
| 1864 | 1,655.434 | 2,512,047 | — 856,613 | 4.167.487 |
| 1865 | 1,615,317 | 2.211,610 | — 596.293 | 3.826.927 |
| 1866 | 1,891,453 | 3,117,034 | —1,225.581 | 5,008.487 |
| 1867 | 2.145.691 | 3.120,695 | — 975,004 | 5.266.386 |
| 1868 | 2,465.695 | 3,105,826 | — 640,131 | 5,571,521 |
| 1869 | 2,459,336 | 3,572,644 | —1,113,308 | 6.031,980 |
| 1870 | 2,452.226 | 3,817,963 | —1,365,737 | 6.270.189 |
| 1871 | 2.603,591 | 4,390,606 | —1,787,015 | 6,994,197 |
| 1872 | 2.584,646 | 5,185.340 | —2,600.694 | 7.769.936 |
| 1873 | 2,443,285 | 5,951,464 | —3,508,179 | 8,294.749 |
| 1874 | 2,914,942 | 7,094,713 | —4,179.771 | 10,009.655 |
| 1875 | 2,887,153 | 6,255.985 | —3,368.832 | 9.143.138 |
| 1876 | 2,927,780 | 6,788,124 | —3,860.344 | 9.715,904 |
| 1877 | 2,957,791 | 7,418,697 | —4,490,906 | 10,406.488 |
| 1878 | 3,009,437 | 8,521,090 | —5.511,653 | 11,530,527 |
| 1879 | 3,049.743 | 10,718,394 | —7.668.651 | 13.768.137 |
| 1880 | 3,128,374 | 12,111,160 | —8,982.786 | 15.239,534 |

The + and — marks indicate respectively the years when the American tonnage exceeded the foreign, and the years when the foreign exceeded the American.

The commerce of the United States, both in the exportation and importation of goods and products, has advanced with great rapidity. The following table shows the extraordinary rapidity of its increase, as compared with that of Great Britain and France, the two greatest commercial nations of the world:—

NATIONAL EXPORTS.

| Year. | United States. | Great Britain. | France. |
|---|---|---|---|
| 1800 | $31,480,903 | $118,413,084 | $53.750,816 |
| 1819 | 64,974,382 | 176,057,005 | 83.095.885 |
| 1829 | 72,358,671 | 179,213.115 | 121,563,730 |
| 1839 | 121,028,416 | 266.167.900 | 188,101,247 |
| 1849 | 145,755.820 | 317,980.125 | 207.281,108 |
| 1860 | 400.122,296 | 664.782.635 | 424.950,000 |
| 1865 | 356.697.123 | 1,054,157.880 | 760,000,000 |
| 1870 | 545,674,597 | 1,220,402,885 | 600,000,000 |
| 1875 | 749.385,520 | 1,408.061.615 | 774.520,000 |
| 1878 | 770,707,438 | 1,472,500,000 | 635,940,000 |
| 1879 | 754.189,169 | 1,433,750,000 | 646,260,370 |
| 1880 | 862,129,470 | 1,395,000,000 | 615,400,000 |

The exports of a nation, it should be remembered, are but a part of the surplus remaining after the wants of the people are supplied with the article exported. This is particularly the case with all agricultural products, and the amount of these exported bears often a very small proportion to the whole crop. Of cotton, about one-third the yield is consumed at home; while of breadstuffs, the export in 1880 was $288,036,835, and the total yield of the year was $1,342,-000,000, or about five times the whole export. With each year, too, the proportion of manufactured goods, the product of skill bestowed upon the raw material is increasing; though as yet we are not so far free as we should be from the use of foreign manufactured products; and the many duties which it has been found necessary to impose upon foreign manufactures, so far from diminishing their consumption, have seemed to increase it. The importations of 1880, aside from coin and bullion, which came in payment for goods, were $667,-954,746, larger than in any previous year of our history, although a large proportion of the articles imported pay a duty of from thirty-three to fifty per cent. on its prime cost; but the exports were nearly 200 millions more. We ought to produce our own sugar, our silk goods, our rubber goods, and all our woolen goods; and by so doing we might diminish our imports at least 160 millions more.

The war, which it was predicted would bankrupt the whole country, had just the contrary effect. It developed our resources, caused a vast immigration of skilled labor, and very considerable capital to our western lands, led to the construction of railroads, and the opening up of new territory, to the exploitation of mines, and the exercise of an intense and widely varied industry. Millions of acres, hitherto regarded as utterly barren deserts, buried too deep beneath winter's frost and snow for crops to germinate, or burning beneath the glare of a torrid sun, treeless and rainless, were, a few years later, white with abundant crops of the choicest wheat, or rustling, like the waves of the sea, with the stalks and leaves of the gigantic corn. On all the hillsides thousands of cattle grazed, while white-fleeced sheep covered the lofty plains.

No nation ever accumulated wealth so fast. The true valuation of the property of the country, in 1860, was $16,159,616,-068; that of 1870, after four years of war, and destruction of property to the amount of nearly $8,000,000,000, was $30,068,-518,507. That of 1880 is now in course of compilation, but enough is known of it to make it certain that it will not fall below $60,000,000,000. This includes only a small portion of the railroad property, or of the real value of most of the mining interests, and takes no account of the value of the vast Government domain as yet unsold, or the other Government property, of which no estimate is made. In actual wealth, we surpass the United Kingdom of Great Britain and Ireland, hitherto regarded as the richest nation in the world.

In sixteen years we have paid off more than a thousand millions of our national debt, reducing it from $2,845,907,626, Aug. 31, 1865, to $1,840,598,812, July 1, 1881, with a reduction of nearly 100 millions more probable during the current year. Twelve years ago, our first transcontinental railroad—the Union Pacific—was completed; to-day we have five, three of them completed, and the other two nearing completion. In 1860, we had 30,635 miles of railroad in operation; in 1881, we have 104,000 miles.* North and south, east and west, the lines cross and recross, till the whole land is gridironed with them. All these, as well as the ocean and inland steamers, bear our agricultural, mining, and manufacturing products to the great markets of the world. The vast individual fortunes of Europe are equaled by our railroad kings and bonanza princes.

# EDUCATION AND EDUCATIONAL INSTITUTIONS.

## CHAPTER I.

### EDUCATIONAL DEVELOPMENT IN THE COLONIAL PERIOD.

#### INTRODUCTION.

The origin, nomenclature, and early peculiarities of the systems, institutions, and methods of instruction adopted in the original colonies, which now constitute a portion of the United States of America, will be found in the educational institutions and practices of the countries from which these colonies were settled—modified by the education, character, motives of emigration, and necessities of the settlers themselves.

The earliest effort to establish an educational institution in the English dominions in America, was made under the auspices of King James I, and by contributions of members of the Church of England from 1618 to 1623. In a letter addressed to the Archbishops, he authorizes them to invite the members of the Church throughout the kingdom to assist "those undertakers of that Plantation [Virginia], with the erecting of some churches and schools for the education of the children of those barbarians" [the Aborigines] and of the colonists. Under these instructions, a sum of £1500 was collected for the erection of a building for a college at Henrico—a town whose foundations, or site even, cannot now be certainly determined, but which according to the best authorities was situated near Varina on Cox's Island, about fifty miles above Jamestown. Authority was given by the Company to the Governor to set apart 10,000 acres of land for the support of the college, and one hundred colonists were sent from England to occupy and cultivate the same, who were to receive a moiety of the produce as the profit of their labor, and to pay the other moiety toward the maintenance of the college. In 1620, George Thorpe was sent out as superintendent, and 300 acres of land was set apart for his sustenance. Other donations and legacies were made for the endowment of this institution of learning.

In 1619, the Governor for the time being was instructed by the company to see "that each town, borough, and hundred procured by just means a certain number of their children to be brought up in the first elements of literature; that the most towardly of them should be fitted for college, in the building which they purposed to proceed as soon as any profit arose from the estate appropriated to that use; and they earnestly required their help in that pious and important work." In 1621, Rev. Mr. Copeland, chaplain of the Royal James, on her arrival from the East Indies, prevailed on the ship's company to subscribe £100 toward a "free schoole" in the colony of Virginia, and collected other donations in money and books for the same purpose. The school was located in Charles City, as being most central for the colony, and was called the "*East India School.*" The company allotted one thousand acres of land, with five servants and an overseer, for the maintenance of the master and usher. The inhabitants made a contribution of £1500 to build a house, for which workmen were sent out in 1622.

The "college" and "free school" thus projected and partially endowed were in the style of the "college" and "free school" and the "free grammar school" of England, and were intended to be of the same character as the college afterward established at Cambridge, and the institution for which "the richer inhabitants" of Boston in 1636 subscribed toward "the maintenance of a free schoolmaster," and the same as, according to Governor Winthrop, in his journal, was erected in Roxbury in 1645, and other towns, and for which every inhabitant bound some house or land for a yearly allowance forever, and many benevolently disposed persons left legacies in their last wills, and the towns made "an allowance out of the common stock," or set apart a portion of land "to be improved forever, for the maintenance of a free schoole forever."

The same leading idea can be traced in the educational policy of the Dutch West India Company—which bound itself, in receiving its charter of colonization, "to maintain good and fit preachers, schoolmasters, and comforters of the sick." The company recognized the authority of the established Church of Holland, and the establishment of schools and the appointment of schoolmasters rested conjointly with the company and the classis (ecclesiastical authorities) of Amsterdam. When the company granted a special "Charter of Freedom and Exemptions" to the "Patroons," for the purpose of agricultural colonization, they were not only to satisfy the Indians for the lands upon which they should settle, but were to make prompt provision for the support of a minister and schoolmaster, that thus the service of God and zeal for religion might not grow cold, and be neglected among them. In 1633, in the enumeration of the company's officials at Manhattan, Adam Roelandsen is mentioned as the schoolmaster, and that school, it is claimed, is still in existence in connection with the Reformed Dutch Church of New York. In the projected settlement at New Amstel on the Delaware, the first settlers were encouraged to proceed by certain conditions, one of which was that the city of Amsterdam should send thither "a proper person for a schoolmaster;" and we find among the colonists who embarked, "Evert Pietersen, who had been approved, after examination before the classis, as schoolmaster." In these early efforts to establish schools, we trace the educational policy of the Reformed Church of Holland as indicated by the synod of Wesel in 1568, and matured at the synod of Dort in 1618, by which the training of Christian youth was to be provided for—"I. *In the house, by parents.* II. *In the schools, by schoolmasters.* III. *In the churches, by ministers, elders, and the catechists especially appointed for this purpose.*" Owing in part to the commercial purposes entertained by the companies having charge of the colonization of New York, Virginia, and some other portions of the country, and to the educational and religious institutions of the colonists being not so much a matter of domestic as of foreign policy, these institutions never commanded the regular and constant attention of the local authorities, or of the settlers themselves.

The outline and most of the essential features of the system of common schools now in operation in the New England states, and the states which have since avowedly adopted the same policy, will be found in the practice of the first settlers of the several towns which composed the original colonies of Massachusetts, Connecticut, and New Haven. The first law on the subject did but little more than declare the motive, and make more widely obligatory the practice which already existed in the several neighborhoods and towns, which had grown up out of the education of these colonists at home, and the circumstances in which they were placed. They did not come here as isolated individuals, drawn together from widely separated homes, entertaining broad differences of opinion on all matters of civil and religious concernment, and kept together by the necessity of self-defence in the eager prosecution of some temporary but profitable adventure. They came after God had set them in families, and they brought with them the best pledges of good behavior, in the relations which father and mother, husband and wife, parents and children, neighbors and friends, establish. They came with a foregone conclusion of permanence, and with all the elements of the social state combined in vigorous activity—every man expecting to find or make occupation in the way in which he had been already trained. They came with earnest religious convictions, made more earnest by the trials of persecution; and the enjoyment of these convictions was a leading motive in their emigration hither. The fundamental articles of their religious creed, that the Bible was the only authoritative expression of the divine will, and that every man was able to judge for himself in its interpretation, made schools necessary, to bring all persons "to a knowledge of the Scriptures," and an understanding "of the main grounds and principles of the Christian religion necessary to salvation." The constitution of civil government adopted by them from the outset, which declared all civil officers elective, and gave to every inhabitant who would take the oath of allegiance the right to vote and to be voted for, and which practically converted political society into a partnership, in which each member had the right to bind the whole firm, made universal education identical with self-preservation. But aside from these considerations, the natural and acknowledged leaders in this enterprise—the men who, by their religious character, wealth, social position, and previous experience in conducting large business operations, commanded public confidence in church and commonwealth, were educated men—as highly and thoroughly educated as they could be at the best endowed free and grammar schools in England at that period; and not a few of them had enjoyed the advantages of her great universities. These men would naturally seek for their own children the best opportunities of education which could be provided; and it is the crowning glory of these men, that, instead of sending their own children back to England to be educated in grammar schools and colleges, these institutions were established here amid the stumps of the primeval forests; that, instead of setting up "family schools" and "select schools" for the ministers' sons and magistrates' sons, the ministers and magistrates were found, not only in town meeting, pleading for an allowance out of the common treasury for the support of a public or common school, and in some instances for a "free school," but among the families, entreating parents of all classes to send their children to the same school with their own. All this was done in advance of any legislation on the subject, as will be seen from the following facts gleaned from the early records of several of the towns first planted.

#### TOWN ACTION IN BEHALF OF SCHOOLS.

The earliest records of most of the towns of New England are either obliterated or lost, but among the oldest entries which can now be recovered, the school is mentioned not as a new thing, but as one of the established interests of society, to be looked after and provided for as much as roads and bridges and protection from the Indians. In the first book of records of the town of Boston, under date of April 13, 1634, after providing by ordinance for the keeping of the cattle by "brother Cheesbrough," "it was then generally agreed upon that our brother Philemon Purmont shall be entreated to become schoolmaster for the teaching and nurturing of children with us." This was doubtless an elementary school, for in 1636 we find a subscription entered on the records of the town "by the richer inhabitants," "for the maintenance of a free schoolmaster, for the youth with us—Mr. Daniel Maude being now also chosen thereunto." Mr. Maude was a clergyman, a title at that day and in that community which was evidence of his being an educated man. This "free school" was, in the opinion of the writer, not necessarily a school of gratuitous instruction for all, but an endowed school of a higher grade, of the class of the English grammar school, in which many of the first settlers of New England had received their own education at home. Toward the maintenance of this school, the town, in 1642, in advance of any legislation by the General Court, ordered "Deer Island to be improved," and several persons made bequests in their last wills. Similar provision can be cited from the early records of Salem, Cambridge, Dorchester, and other towns of Massachusetts Bay.

The early records of the town of Hartford are obliterated, but within seven years after the first log-house was erected, thirty pounds are appropriated to the schools, and in April, 1643, it is ordered "that Mr. Andrews shall teach the children in the school one year," and "he shall have for his pains £16, and therefore the townsmen shall go and inquire who will engage themselves to send their children; and all that do so, shall pay for one quarter, at the least, and for more if they do send them, after the proportion of twenty shillings the year; and if they go any week more than one quarter, they shall pay sixpence a week; and if any would send their children and are not able to pay for their teaching, they shall give notice of it to the townsmen, and they shall pay it at the town's charge." Mention is also made of one "Goody Betts," who kept a "Dame School" after the fashion of Shenstone's "schoolmistress" at Leasower, in England. Similar entries are found in the town records of Windsor and Wethersfield in advance of any school code by the colony of Connecticut.

The records of the town of New Haven are full of evidence of the interest taken by the leading spirits of the colony, particularly by Governor Theophilus Eaton and Rev. John Davenport, in behalf of schools of every grade, and of the education of every class, from the apprentice boy to those who filled the high places in church and state. The first settlement of the colony was in 1638, and within a year a transaction is recorded, which, while it proves the existence of a school at that early period, also proclaims the protection which the first settlers extended to the indigent, and their desire to make elementary education universal. In 1639, Thomas Fugill is required by the court to keep Charles Higinson, an indentured apprentice, "at school one year;" or else to advantage him as much in his education as a year's learning comes to. In 1641, the town orders "that a Free School be set up," and "our pastor, Mr. Davenport, together with the magistrates, shall consider what yearly allowance is meet to be given to it out of the common stock of the town, and also what rules and orders are meet to be observed in and about the same." To this school "that famous schoolmaster," Ezekiel Cheever,* "was appointed," "for the better training up of youth in this town, that, through God's blessing, they may be fitted for public service hereafter, in church or commonwealth." Not content with a Grammar School, provision was early made for "the relief of poor scholars at the college at Cambridge," and in 1645 forty bushels of wheat were sent forward for this purpose, and this was followed by other donations, and by a richer consignment of young men to enjoy the advantages of the institution. In 1647, in the distribution of home lots, it was ordered in town meeting, that the magistrates "consider and reserve what lot they shall see meet, and most commodious for a college, which they desire may be set up so soon as their ability will reach thereunto." Among the active promoters of education and schools, the name of Governor Eaton, in connection with Mr. Davenport, is particularly prominent. In 1652, he calls a meeting of the magistrates and elders "to let them know what he has done for a schoolmaster;" that he had written a letter to one Mr. Bower, a schoolmaster of Plymouth, and another to Rev. Mr. Landron, a scholar; and many of the town thought there would be need of two schoolmasters—"one to teach boys to read and write," as well as the "Latin schoolmaster." At another time he reports his correspondence with a teacher in Wethersfield, then with one at old Plymouth, and again with one at Norwalk, "so that the town might never be without a sufficient schoolmaster." He seems to have been considerate of the health of the teachers, and proposes to excuse one "whose health would not allow him to go on with the work of teaching," which he seems to regard as more laborious than that of the ministry. On another occasion he introduces to the committee a schoolmaster who has come to treat about the school. He is allowed £20 a year, and 30 shillings for his expenses in travel, besides his board and lodgings. He wished to have liberty to visit his friends, "which he proposed to be in harvest time, and that his pay be such as wherewith he may buy books." These particulars show the considerate interest taken by men in local authority in the school and the teacher, in advance of any directory or compulsory legislation of the colony of New Haven. It was owing, in part, to the timely suggestions of Rev. Mr. Davenport, that Gov. Edward Hopkins, of Connecticut, by his will, dated London, March 7, 1657, bequeathed the residue of his estate (after disposing of much of his estate in New England) to trustees residing in New Haven and Hartford, "in full assurance of their trust and faithfulness" in disposing of it, "to give some encouragement in those foreign plantations for the breeding up of hopeful youths both at the grammar school and college, for the public service of the country in future times." By the final disposition and distribution of this estate three grammar schools were established at New Haven, Hartford, and Hadley, which are in existence at this day, among the oldest institutions of this class in America.

The early records of the several towns which subsequently constituted a portion of the colony of New Hampshire, exhibit evidence of a different character and spirit in the first settlers. The plantations on the Piscataqua river were made by proprietors from mere commercial motives, and the settlers were selected in reference to immediate success in that direction; and in these settlements we find no trace of any individual or town action in behalf of education until after their union with the colony of Massachusetts, whose laws made the establishment of schools obligatory.

In the early records of the Rhode Island and Providence Plantations, we find traces of the same educational policy which marked the early history of towns in Massachusetts and Connecticut. According to Callender, in Newport, "so early as 1640, Mr. Lenthal was by vote called to keep a public school for the learning of youth, and for

*See Barnard's *American Teachers and Educators*, vol. i., art. "Ezekiel Cheever."

his encouragement there were granted to him and his heirs, one hundred acres of land, and four more for a house lot. It was also voted that one hundred acres should be appropriated for a school for encouragement of the poorer sort to train up their youth in learning. And Mr. Robert Lenthal, while he continues to keep school, is to have the benefit thereof." The proprietors of other plantations reserved a portion of land for the maintenance of schools, and generally of a "free schoole;" and "Mr. Schoolmaster Turpin," petitions the town of Providence, that he and his heirs, so long as any of them should maintain the worthy art of learning, may be invested in the lands set apart for a school.

These citations show the action of the towns independent of any general legislation by the several colonies of New England—action prompted by their own consciousness of the advantages of education in "Dame Schools," in "Free Schools," in "Grammar Schools" and in "Colleges" at home—aided by the presence among them of "masters" and "ushers," and also of "schoolmasters" and "schoolma'ams" willing to engage in the same vocations in the new townships and villages—stimulated by magistrates and ministers, who had themselves received the best education that such schools could give in England, who inculcated the reading of the Scriptures as of daily obligation, and who believed that the foundations of the state should be laid in the virtue and intelligence of the whole people.

### COLONIAL LEGISLATION AND ACTION.

We shall now notice briefly the legislation respecting children and schools of each of the colonies, in the order of their settlement.

VIRGINIA.—Although several attempts were made to establish "Free Schools" and a "College" in Virginia, by the Virginia Company and benevolent individuals, at an earlier day, the first general legislation respecting the education of children by the Colonial Assembly was in 1631, when it was enacted: "It is also thought fit, that upon every Sunday the mynister* shall, halfe an hour or more before evening prayer, examine, catechise, and instruct the youths and ignorant persons of his parish in the ten commandments, the articles of the beliefe, and in the Lord's prayer; and shall diligentlie heere, instruct, and teach the catechisme, sett forth in the book of Common Prayer. And all fathers, mothers, maysters, and mistrisses, shall cause their children, servants, or apprentices, which have not learned their catechisme, to come to church at the time appoynted, obedientlie to heare, and to be ordered by the mynister untill they have learned the same. And yf any of sayd fathers, mothers, maysters & mistresses, children, servants, or apprentices, shall neglect their duties, as the one sorte in not causinge them to come, and the other in refusinge to learne as aforesayd, they shall be censured by the corts in these places holden." To secure the execution of this last clause, it is provided in the oath of the warden, taken before "the justices for the monthlie corts"—"they shall present such mastyrs and mistresses as shall be delinquent in the catechisinge the youth and ignorant persons. So help you God."

In 1660 an attempt was made to found a college for the supply of educated clergymen. "Whereas the want of able and faithful ministers in this country deprives us of those great blessings and mercies that always attend upon the service of God; which want, by reason of the great distance from our native country, cannot in all probability be always supplied from thence: *Be it enacted*, that for the advance of learning, education of youth, supply of the ministry, and promotion of piety, there be land taken for a college and free school with as much speed as may be convenient, houses erected thereon for entertainment of students and scholars." In the same year it was ordered that a petition be drawn up by the General Assembly to the king for a college and free school; and that there be his letters patent "to collect the charity of well disposed persons in England, for the erecting of colledges & schools in this countrye," and also to bestow universities "to furnish the church here with ministers for the present." And this petition was recommended to the right honorable Governor, Sir William Berkeley. Sir William does not appear, in his reply to the Lords Commissioners of Foreign Plantations, dated 1670, to have been very kindly disposed to public schools of high or low degree.

"Question 23. What course is taken about the instructing the people within your government in the Christian religion;

* In this and some other quotations we have followed the orthography of the original.

and what provision is there made for the payment of your ministry?"

"*Answer*. The same course that is taken in England out of towns; every man according to his ability instructing his children. We have forty-eight parishes, and our ministers are well paid, and by my consent should be better if they would pray oftener and preach less. But of all other commodities, so of this, the worst are sent us, and we had few that we could boast of, since the persecution in Cromwell's tyranny drove divers worthy men hither. But I thank God there are no free schools, nor printing, and I hope we shall not have these hundred years; for learning has brought disobedience and heresy and sects into the world, and printing has divulged them, and libels against the best government. God keep us from both!"

In 1691, "the good design of building a free school and college for the encouragement of learning," was recognized, but it was not till 1693 that an act was passed locating the college, for which a royal charter had been obtained April 8, 1692, with the title of William and Mary, at Middle Plantation, afterward Williamsburgh. Toward its endowment the royal founders granted £2000 in money, land, and a revenue duty on tobacco; and the Assembly enacted an export duty on skins and furs. The money grant of £2000 did not meet with much encouragement from the English Attorney General (Seymour) who was instructed to prepare the charter, who remarked to the Rev. James Blair, the agent of the colony for this purpose, that the money was wanted for other purposes, and that he did not see the slightest occasion for a college in Virginia. The agent represented that the intention of the colony was to educate and qualify young men to be ministers of the Gospel, and begged Mr. Attorney would consider that the people of Virginia had souls to be saved as well as the people of England. "Souls!" said he; "damn your souls! make tobacco." The plan of the building was designed by Sir Christopher Wren. The first commencement was held in 1700, at which, according to Oldmixon, "there was a great concourse of people; several planters came thither in their coaches, and several sloops from New York, Pennsylvania and Maryland; it being a new thing in America to hear graduates perform their academical exercises. The Indians themselves had the curiosity to come to Williamsburgh on this occasion; and the whole country rejoiced as if they had some relish of learning." After the English fashion, the college had a representative in the General Assembly. As a quitrent for the land granted by the Crown, the students and professors every year marched to the residence of the royal Governor, and presented, and sometimes recited, some Latin verses. On the breaking out of the Revolution the endowments of the college were cut off, and its constitution was somewhat changed.

No general school law was established in Virginia until 1796, although a plan was proposed by Mr. Jefferson in 1779, which recognized three degrees of public instruction, viz.: 1. Elementary schools for all children. 2. Colleges for an extension of instruction suitable for the common purposes of life. 3. A university, an extension of the means of higher culture on the basis of the college at Williamsburgh.

Scattered through the colony were schools in connection with churches, both Episcopal and Presbyterian, and in many families private teachers were employed, and in some cases sons were sent out to England to complete their education.

Massachusetts.—In 1636, six years after the first settlement of Boston, the General Court of the colony of Massachusetts Bay, which met in Boston on the 8th of September, passed an act appropriating £400 toward the establishment of a college. The sum thus appropriated was more than the whole tax levied on the colony at that time in a single year, and the population scattered through ten or twelve villages did not exceed five thousand persons; but among them were eminent graduates of the university of Cambridge, in England, and all were here for purposes of permanent settlement. In 1638, John Harvard left by will the sum of £779 in money, and a library of over three hundred books. In 1640 the General Court granted to the college the income of the Charlestown ferry; and in 1642 the Governor, with the magistrates and teachers and elders, were empowered to establish statutes and constitutions for the infant institution, and in 1650 granted a charter which still remains the fundamental law of the oldest literary institution in this country.

In 1642 the attention of the General Court was turned to the subject of family instruction in the following enactment:—

"Forasmuch as the good education of children is of singular behoof and benefit to any commonwealth; and whereas many parents and masters are too indulgent and negligent of their duty in this kind:

"*It is therefore ordered by this Court and the authority thereof*, That the selectmen of every town, in the several precincts and quarters where they dwell, shall have a vigilant eye over their brethren and neighbors, to see, first, that none of them shall suffer so much barbarism in any of their families, as not to endeavor to teach, by themselves or others, their children and apprentices so much learning as may enable them perfectly to read the English tongue, and knowledge of the capital laws, upon penalty of twenty shillings for each neglect therein; also, that all masters of families do, once a week, at least, catechise their children and servants in the grounds and principles of religion, and if any be unable to do so much, that then, at the least, they procure such children or apprentices to learn some short orthodox catechism, without book, that they may be able to answer to the questions that shall be propounded to them out of such catechisms by their parents or masters, or any of the selectmen, where they shall call them to a trial of what they have learned in this kind; and further, that all parents and masters do breed and bring up their children and apprentices in some honest lawful calling, labor or employment, either in husbandry or some other trade profitable for themselves and the commonwealth, if they will not nor cannot train them up in learning to fit them for higher employments; and if any of the selectmen, after admonition by them given to such masters of families, shall find them still negligent of their duty in the particulars aforementioned, whereby children and servants become rude, stubborn and unruly, the said selectmen, with the help of two magistrates, shall take such children or apprentices from them, and place them with some masters for years, boys till they come to twenty-one, and girls eighteen years of age complete, which will more strictly look unto and force them to submit unto government, according to the rules of this order, if by fair means and former instructions they will not be drawn unto it."

In the same year the following general school law was enacted:—"It being one chief project of that old deluder, Satan, to keep men from the knowledge of the Scriptures, as in former times, keeping them in an unknown tongue, so in these latter times, by persuading from the use of tongues, so that at least the true sense and meaning of the original might be clouded and corrupted with false glosses of deceivers; and to the end that learning may not be buried in the grave of our forefathers, in church and commonwealth, the Lord assisting our endeavors:

"*It is therefore ordered by this Court and authority thereof*, That every township within this jurisdiction, after the Lord hath increased them to the number of fifty householders, shall then forthwith appoint one within their town to teach all such children, as shall resort to him, to write and read, whose wages shall be paid, either by the parents or masters of such children, or by the inhabitants in general, by way of supply, as the major part of those who order the prudentials of the town shall appoint; provided, that those who send their children be not oppressed by paying much more than they can have them taught for in other towns.

"*And it is further ordered*, That where any town shall increase to the number of one hundred families or householders, they shall set up a grammar school, the masters thereof being able to instruct youths so far as they may be fitted for the university, and if any other town neglect the performance hereof above one year, then every such town shall pay five pounds per annum to the next such school, till they shall perform this order."

With various modifications as to details, but with the same objects steadily in view, viz., the exclusion of "barbarism" from every family, by preventing its having even one untaught and idle child or apprentice, the maintenance of an elementary school in every neighborhood where there were children enough to constitute a school, and of a Latin school in every large town, and of a college for higher culture for the whole colony, the colonial legislature, and the people in the several towns of Massachusetts, maintained an educational system, which, although not as early or as thorough as the school code of Saxony and Wirtemberg, has expanded with the growth of the community in population, wealth, and industrial development, and stimulated and shaped the legislation and efforts of other states in behalf of universal education.

The early records of the colony of Plymouth contain no trace of the zeal for schools which characterized the colonies of Massachusetts Bay, Connecticut, and New Haven. In 1662 the profits of the codfishery were appropriated to the maintenance of grammar schools in such towns as would make arrangements for the same; and in 1669 towns having fifty families were authorized to raise by rate on all the inhabitants the sum of twelve pounds for this class of schools, "for as much as the maintenance of good literature doth much tend to the advancement of the weal and flourishing state of societies and republics." After the union of the two colonies under one charter, several towns in the old colony were fined for not complying with the provisions of the law of 1647 respecting children and schools.

In addition to the grammar school which each town having one hundred families was obliged by law to maintain, to enable young men to fit for college, in several counties endowed schools were set up; and in 1763 the first of that class of institutions, known and incorporated as academies, was established in the parish of Byfield in the town of Newbury, on a legacy left by Gov. William Dummer. Its objects were the same as those of the town grammar school, but its benefits were not confined to one town, nor was it supported in any degree by taxation.

Rhode Island.—In this colony education was left to individual and parental care, no trace of any legislation on the subject being found in the proceedings of the General Assembly, except to incorporate in 1747 the "Society for the Promotion of Knowledge and Virtue," which was established in Newport in 1730 by the name of the "Company of the Redwood Library;" and in 1764 to grant the charter to the College of Rhode Island, which was first located in Warren, and in 1770 removed to Providence, and in 1804 called, after its most liberal benefactor, Brown University.

Connecticut.—In 1646, Mr. Roger Ludlow was requested to compile "a body of laws for the government of this commonwealth," which was not completed till May, 1650, and is known as the code of 1650. The provisions for the family instruction of children and the maintenance of schools are identically the same as in Massachusetts, and remained on the statute-book, with but slight modifications to give them more efficiency, for one hundred and fifty years. In the chapter on "capital" offences, it is enacted that if any child above sixteen years of age, and of sufficient understanding, shall curse or smite his father or mother, he shall be put to death, "unless it can be sufficiently testified that the parents have been unchristianly negligent in the education of such children." In the chapter respecting schools, the proposition made by the "Commissioners of the United Colonies," that it be commended to every family which "is able and willing to give yearly but the fourth part of a bushel of corn, or something equivalent thereto," "for the advancement of learning," was approved, and two men were appointed in every town to receive and forward the contributions. This was done in the larger towns of the colonies of Connecticut and New Haven, from time to time, until ten of the principal ministers, in 1700, at Branford, brought each a number of books, and as they laid them on the table, declared—"*I give these books for founding a College in Connecticut*;" and on that foundation rose Yale College. To fit young men for the college at Cambridge, and subsequently for Yale, in 1672 it was ordered by the General Court, "that in every county there shall be set up a grammar school for the use of the county, the master thereof being able to instruct youths so far as they may be fitted for college;" and to aid the county towns in maintaining their schools, six hundred acres of land were appropriated by the General Court to each, "to be improved in the best manner that may be for the benefit of a grammar school in said towns, and to no other use or end whatsoever;" and in 1677 a fine of ten pounds annually is imposed on any county town neglecting to keep the Latin school. In 1690, the county Latin schools of Hartford and New Haven are denominated "Free Schools," probably in reference to the partial endowment of schools of this class by the trustees of the legacy of Governor Hopkins.

As early as 1700, the system of public instruction in Connecticut embraced the following particulars:

1. An obligation on every parent and guardian of children, "not to suffer so much barbarism in any of their families as to have a single child or apprentice unable to read the holy word of God, and the good laws of the colony;" and also, "to bring them up to some lawful calling or employment," under a penalty for each offence.

2. A tax of forty shillings on every thousand pounds of the lists of estates, was collected in every town with the annual state tax, and payable proportionably to those towns only which should keep their schools according to law.

3. A common school in every town having over seventy families, kept for at least six months in the year.

4. A grammar school in each of the four head county towns to fit youth for college, two of which grammar schools were free or endowed.

5. A collegiate school, toward which the General Court made an annual appropriation of £120.

6. Provision for the religious instruction of the Indians.

The system, therefore, embraced every family and town, all classes of children and youth, and all the then recognized grades of schools. There were no select or sectarian schools to classify society at the roots, but all children were regarded with equal favor, and all brought under the assimilating influence of early associations and similar school privileges. Here was the foundation laid, not only for universal education, but for a practical, political, and social equality, which has never been surpassed in the history of any other community.

New Hampshire.—From 1623 to 1641, the early records of the first settlements within the present limits of New Hampshire exhibit no trace of educational enactments; from 1641 to 1680, the school laws of Massachusetts prevailed, and the presence of such men as Philemon Purmont and Daniel Maude, who were the first schoolmasters of that colony, must have contributed to inaugurate the policy of local and endowed schools. When the necessities of the college at Cambridge were made known, the people of Portsmouth, in town meeting, made a collection of sixty pounds, with a pledge to continue the same amount for seven years, "for the perpetuating of knowledge both religious and civil among us and our posterity after us." In the original grants for towns one lot was reserved for the support of schools.

In 1680 New Hampshire became a separate colony, and in 1693 the Colonial Assembly enacted "that for the building and repairing of meeting houses, ministers' houses, and allowing a salary to a schoolmaster in each town within this province, the selectmen shall raise by an equal rate an assessment upon the inhabitants;" and in 1719 it was ordained that every town having fifty householders should be constantly provided with a schoolmaster to teach children to read and write; and those having one hundred should maintain a grammar school, to be kept by some decent person, of good conversation, well instructed in the tongues. In 1721 it was ordered that not only each town but each parish of one hundred families should be constantly provided with a grammar school, or forfeit the sum of twenty pounds to the treasury of the province. This system of elementary and secondary instruction continued substantially until the adoption of the state constitution in 1792.

In 1770 Dr. Wheelock removed a school which he had established in Lebanon, Connecticut, under the name of "Moor's Indian Charity School," to the depths of the forests in the western part of New Hampshire. Here, side by side with the school for Indians, he organized another institution, termed a college in the charter granted by Governor Wentworth in 1769, and which held its first commencement in 1771, with four graduates, one of whom was John Wheelock, the second president of the institution, which was called Dartmouth College after Lord Dartmouth, one of the largest benefactors of the Charity School.

At the close of the colonial period of our history, according to Noah Webster, the condition of the educational system in Connecticut and New England was as follows:

"The law of Connecticut ordains that every town or parish containing seventy householders, shall keep an English school, at least eleven months in the year; and towns containing a less number, at least six months in the year. Every town keeping a public school is entitled to draw from the treasury of the state a certain sum of money, proportioned to its census in the list of property which furnishes the rule of taxation. This sum might have been originally sufficient to support one school in each town or parish, but in modern times is divided among a number, and the deficiency of money to support the schools is raised upon the estates of the people, in the manner the public taxes are assessed. To extend the benefits of this establishment to all the inhabitants, large towns and parishes are divided into districts, each of which is supposed able to furnish a competent number of scholars for one school. In each district a house is erected for the purpose by the inhabitants of that district, who hire a master, furnish wood, and tax themselves to pay all expenses not provided for by the public money. The school is kept during the winter months, when every farmer can spare his sons. In this manner, every child in the state has access to a school. In the summer, a woman is hired to teach small children, who are not fit for any kind of labor. In the large towns, schools, either public or private, are kept the whole year; and in every county town, a grammar school is established by law.

"The beneficial effects of these institutions will be experienced for ages. Next to the establishments in favor of religion, they have been the nurseries of well-informed citizens, brave soldiers and wise legislators. A people thus informed are capable of understanding their rights and of discovering the means to secure them. In the next place, our forefathers took measures to preserve the reputation of schools and the morals of youth, by making the teaching them an honorable employment. Every town or district has a committee, whose duty is to procure a master of talents and character; and the practice is to procure a man of the best character in the town or neighborhood. The wealthy towns apply to young men of liberal education, who, after taking the bachelor's degree, usually keep school a year or two before they enter upon a profession. One of the most unfortunate circumstances to education in the Middle and Southern states, is an opinion that school-keeping is a mean employment, fit only for persons of low character. The wretches who keep the schools in those states very frequently degrade the employment; but the misfortune is, public opinion supposes the employment degrades the man: of course no gentleman will undertake to teach children while in popular estimation he must forfeit his rank and character by the employment. Until public opinion is corrected by some great examples, the common schools, what few there are in those states, must continue in the hands of such vagabonds as wander about the country."

"Nearly connected with the establishment of schools is the circulation of newspapers in New England. This is both a consequence and a cause of a general diffusion of letters. In Connecticut, almost every man reads a paper every week. In the year 1785, I took some pains to ascertain the number of papers printed weekly in Connecticut and in the Southern states. I found the number in Connecticut to be nearly eight thousand; which was equal to that published in the whole territory south of Pennsylvania. By means of this general circulation of public papers, the people are informed of all political affairs; and their representatives are often prepared to deliberate on propositions made to the legislature.

"Another institution favorable to knowledge is the establishment of parish libraries. These are procured by subscription, but they are numerous, the expense not being considerable, and the desire of reading universal. One hundred volumes of books, selected from the best writers, on ethics, divinity, and history, and read by the principal inhabitants of a town or village, will have an amazing influence in spreading knowledge, correcting the morals, and softening the manners of a nation. I am acquainted with parishes where almost every householder has read the works of Addison, Sherlock, Atterbury, Watts, Young, and other similar writings; and will converse well on the subjects of which they treat."

New York.—In the early history of the settlements of the New Netherlands, the school was regarded as an appendage of the church, and the schoolmaster was paid in part out of the funds of the government. Down to its organization as a royal province of England, a parochial school existed in every parish.. In 1658 a petition of the burgomasters and schepens of New Amsterdam was forwarded to the West India Company, in which "it is represented that the youth of this place and the neighborhood are increasing in number gradually, and that most of them can read and write, but that some of the citizens and inhabitants would like to send their children to a school the principal of which understands Latin, but are not able to do so without sending them to New England; furthermore, they have not the means to hire a Latin schoolmaster, expressly for themselves, from New England, and therefore they ask that the West India Company will send out a fit person as Latin schoolmaster, not doubting that the number of persons who will send their children to such teacher will from year to year increase, until an academy shall be formed whereby this place to great splendor will have attained, for which, next to God, the honorable company which shall have sent such teacher here shall have laud and praise." In compliance with this petition, Dr. Alexander Carolus Curtius, a Latin master of Lithuania, was sent out by the company. The burgomasters proposed to give him five hundred guilders annually out of the city treasury, with the use of a house and garden, and the privilege of collecting a tuition of six guilders per quarter of each scholar. Dr. Curtius proved not to be a good disciplinarian, and parents complained to the authorities that "his pupils beat each other, and tore the clothes from each other's backs." The doctor retorted that he could not interfere, "as his hands were tied, as some of the parents forbade him punishing their children." He accordingly gave up his place and returned to Holland, and was succeeded in the mastership by Rev. Ægidius Luyck in 1662. His school had a high reputation, and was resorted to by pupils from Virginia, Fort Orange, and the Delaware.

After the establishment of the English authority, the governor claimed the privilege of licensing teachers even for the church schools, but no general school policy was established. In 1702 a free grammar school was founded and built on the King's Farm, and in 1732 a "Free School," for teaching the Latin and Greek and practical branches of mathematics, was incorporated by law. The preamble of the act of incorporation opens as follows: "Whereas the youth of this colony are found by manifold experience to be not inferior in their natural genius to the youth of any other country in the world, therefore be it enacted," etc. In 1710, the Society for the Propagation of the Gospel in Foreign Parts established a charity school in connection with the Episcopal church, which is still in existence, and is now known as the Trinity School. In 1750, Charles Dutens announced to the public "that he taught a school for the use of young ladies and gentlemen, whose love of learning might incline them to take lessons from him in French, at his house on Broad street, near the Long Bridge, where he also makes and vends finger and ear rings, solitaires, stay-hooks and lockets, and sets diamonds, rubies, and other stones. Science and virtue are two sisters, which the most part of the New York ladies possess," etc.

Judge Smith, in his "History of the Province of New York," when speaking of the action of the legislature for founding a college in 1746, says: "To the disgrace of our first planters, who beyond comparison surpassed their eastern neighbors in opulence, Mr. Delancy, a graduate of the University of Cambridge (England), and Mr. Smith, were for many years the only academics in this province, except such as were in holy orders; and so late as the period we are now examining (1750), the author did not recollect above thirteen men, the youngest of whom had his bachelor's degree at the age of seventeen, but two months before the passing of the above law, the first toward erecting a college in this colony, though at a distance of above one hundred and twenty years after its discovery and settlement of the capital by Dutch progenitors from Amsterdam."

In 1754 a royal charter was obtained for a college in New York, with the style of King's College, which came into possession of a fund raised by a lottery authorized for this purpose by the Assembly in 1746, and of a grant of land conveyed to its governors by Trinity Church in 1755. Out of this grant, Columbia College is now (1860) realizing an income of $60,000 a year. The first commencement was celebrated in 1758.

"For the advantage of our new intended college" (King's), "and the use and ornament of the city," a number of eminent citizens of New York, in 1754, united in an association to form a library, which in 1772 was incorporated with the title of the "New York Society Library."

Maryland.—The first settlement was effected within the present limits of Maryland in 1634; and in the years immediately following, we find no record of any marked individual or legislative effort to establish institutions of learning. The first act of the colonial Assembly is entitled a "Supplicatory Act to their sacred majesties for erecting of schools," which was passed in 1694, and repealed or superseded by an act entitled a "Petitionary Act" for the same purpose. Appealing to the royal liberality, which had been extended to the neighboring colony of Virginia in the institution of the college, "a place of universal study," the Assembly ask, "that for the propagation of the Gospel, and the education of the youth of this province in good letters and manners, that a certain place or places for a free school or schools, or place of study of Latin, Greek, writing and the like, consisting of one master, one usher, and one writing-master or scribe to a school, and 100 scholars," be established in Arundel County, of which the Archbishop of Canterbury should be chancellor, and to be called "King William's School;" and a similar free school is asked for in each county, to be established from time to time as the resources of the several counties may suffice. To increase the educational resources of the counties, in 1717 it was enacted that an additional duty of twenty shillings current money per poll should be levied on all Irish servants, being papists, to prevent the growth of popery by the importation of too great a number of them into this province, and also an additional duty of twenty shillings current money per poll on all negroes, for raising a fund for the use of public schools. In 1723, "an act for the encouragement of learning, and erecting schools in the several counties," was passed, with a preamble setting forth that preceding Assemblies have had it much at heart, "to provide for the liberal and pious education of the youth of the province, and improving their natural abilities and acuteness (which seem not to be inferior to any), so as to be fitted for the discharge of their duties in the several stations and employments in it, either in regard to church or state." By this act seven visitors are appointed in each county, with corporate powers to receive and hold estate to the value of £100 per annum; and they are authorized with all convenient speed to purchase, out of funds realized from revenues already set apart for this purpose, one hundred acres more or less, one moiety of which is to serve for making corn, grain, and pasturage for the benefit and use of the master, who is prohibited growing tobacco, or permitting it by others on said farm. The visitors are directed to employ good schoolmasters, members of the Church of England, and of pious and exemplary lives and conversation, and capable of teaching well the grammar, good writing, and the mathematics, if such can be conveniently got, on a salary of £20 per annum, and the use of the plantation. In 1728 the master of each public school is directed "to teach as many poor children gratis as the majority of the visitors should order."

Up to the establishment of the state government in 1777, there was no system of common schools for elementary instruction in operation in Maryland. "A free school," like the free endowed grammar school of England, was established in a majority of counties, two of which were subsequently converted into colleges, that of Charlestown in Kent county, into Washington College in 1782, and the second at Annapolis into St. John's College in 1784—the former "in honorable and perpetual memory of his excellency General Washington, the illustrious and virtuous commander-in-chief of the armies of the United States."

In 1696, Rev. Thomas Bray, then residing in the parish of Sheldon, England, was made commissary of Maryland, to establish the Church of England in the colony. His first act was to inaugurate a plan of parochial libraries for the use of ministers in each parish. Through his influence, Princess Anne made a benefaction for this purpose, and in acknowledgment of the honor of having the capital of the province called after her name (Annapolis), donated books to the value of four hundred pounds to the parish library, which he called "the Annapolitan Library." By his influence in England a plan of "lending-libraries" was projected in every deanery throughout the kingdom, and carried out.

New Jersey.—In the history of New Jersey as a colony we find no trace of any general legislation or governmental action in behalf of schools. Scattered at wide intervals over the state were schools kept by clergymen in connection with their churches.

In 1748 a charter of incorporation for the College of New Jersey was obtained from George II., during the administration of Governor Belcher, "for the instruction of youth in the learned languages and liberal arts and sciences." During the administration of Governor Franklin in 1770, a second college was chartered, with the name of Queen's (now Rutger's) College, as a school of theology for the Reformed Dutch Church. Neither of the institutions received any aid from the government.

Pennsylvania.—The frame of government of the province of Pennsylvania, dated April 25th, 1682, drawn up by William Penn before leaving England, contains the following provision: "The governor and provincial council shall erect and order all public schools and reward the authors of useful sciences and laudable inventions in said province." In the laws agreed upon a few months later in the same year by the governor and divers freemen of the province in England, it is provided "that all children within this province of the age of twelve years shall be taught some useful trade, or skill, to the end that none be idle, but that the poor may work to live, and the rich, if they become poor, may not want." In 1683 the governor and council in Philadelphia, "having taken into their serious consideration the great necessity there is of a schoolmaster in the town of Philadelphia, sent for Enoch Flower, an inhabitant of said town, who for twenty years past hath been exercised in that care and employment in England, to whom having communicated their minds, he embraced it upon the following terms: to learn to read English, 4s. by the quarter;" to learn to read and write, 6s.; read, write and cast accounts, 8s.; for boarding a scholar, £10 per year. In 1689 the Society of Friends established a Latin school of which George Keith was the first teacher. In 1725 Rev. Francis Alison, a native of Ireland, but educated at Glasgow, became pastor of the Presbyterian church in New London, in Chester county, and opened a school there, which had great reputation. He at one time resided at Thunder Hill, in Maryland, where he educated many young men who were afterward distinguished in the Revolutionary struggle. He was subsequently Provost of the college at Philadelphia.

In 1749 Benjamin Franklin published his "*Proposals relating to the Education of Youth in Pennsylvania*," out of which originated subsequently an academy and charity school, and ultimately the University of Pennsylvania. At the head of the English department of the academy in 1751 was Mr. Dove, who was then engaged in giving public lectures in experimental philosophy with apparatus—an early lyceum or popular lecturer.

In 1743 the American Philosophical Society originated in a "Proposal for Promoting Useful Knowledge," published by Benjamin Franklin, which, after various forms of organization, took its present name and shape on the 2d of January, 1769.

In 1765 the Medical School originated with the appointment of Dr. Morgan to the professorship of the theory and practice of physic; in 1767 it was fully organized, and in 1768 degrees in medicine were for the first time conferred.

Among the denominational schools which grew up in the absence of any general legislation on the subject, was a Moravian school for boys at Nazareth in 1747, and for girls at Bethlehem 1749, both of which are still in existence, and the latter, especially, since 1789, has been one of the most flourishing female seminaries in this country.

Delaware.—In the early settlements of the Swedes and Dutch in Delaware, the policy of connecting a school with the church was probably imperfectly carried out, but there is no historical trace of its existence. The only school legislation of the colony extant, is an act incorporating "the Trustees of the Grammar School in the borough of Wilmington, and county of New Castle," dated April 10, 1773.

North Carolina.—In North Carolina for fifty years, the policy of the provincial authorities was to discourage all forms of religious and educational activity outside of the Church of England, to the extent of forbidding expressly the establishment of printing presses. The first act on record relating to schools, in 1764, was "for the building of a house for a school, and the residence of a schoolmaster in the town of Newbern"—appropriating the half of two lots, before set apart for a church, for this purpose. In 1766 another act was passed incorporating trustees for this school, with the preamble "that a number of well-disposed persons, taking into consideration the great necessity of having a proper school, or public seminary of learning established, whereby the present generation may be brought up and instructed in the principles of the Christian religion, and fitted for the several offices and purposes of life, have at great expense erected a school-house for this purpose;" and providing that the master of the school shall be "of the established Church of England, and licensed by the governor." Similar acts were passed in 1770 and 1779 for schools at Edenton and Hillsborough. In 1770 an act, reciting that a very promising experiment had been made in the town of Charlotte in the county of Mecklenburg, with a seminary of learning "a number of youths there taught making great advancement in the knowledge of the learned languages, and in the rudiments of the arts and sciences, having gone to various colleges in distant parts of America," incorporates the same with the name of Queen's College. This act was repealed by proclamation in the next year, but in 1777 it was reincorporated by name of "Liberty Hall." With the downfall of the royal authority, and the religious party which had swayed the colony, a new educational policy was inaugurated.

South Carolina.—In the early history of the colony of South Carolina, as of several other colonies, the first efforts to establish schools were in connection with the predominant church of the settlers, *i. e.*, of the Church of England, through the aid of the "Venerable Society for Propagating the Gospel in Foreign Parts." By the missionaries of that society charity schools were established in several parishes, some of which were afterward endowed by individuals, and incorporated by act of the legislature, and called "Free Schools." In 1710 a free school of this character was established at Goosecreek, and in 1712 in Charleston; and by the general act of February 22, 1722, the justices of the county courts were authorized to erect a free school in each county and precinct, to be supported by assessment on land and negroes. These schools were bound to teach ten poor children each, if sent by said justices. In 1724, a memorial to the "Venerable Society" from the parish of Dorchester sets forth—"The chief source of irreligion here is the want of schools; and we may justly be apprehensive, that if our children continue longer to be deprived of opportunities of being instructed, Christianity will of course decay insensibly, and we shall have a generation of our own as ignorant as the native Indians." The society sent out schoolmasters to this and other parishes, and about 2000 volumes of bound books. In 1721 Mr. Richard Beresford bequeathed to the parish of St. Thomas and St. Dennis, in trust, for the purpose of educating the poor, £6500; and in 1732 Mr. Richard Harris, for the same object, £1000. In 1728 Rev. Richard Ludlam bequeathed his whole estate to the parish of St. James, which in 1778 amounted to £15,272. Other bequests for the same objects were made at different times before the Revolution. In 1743 Rev. Alexander Garden wrote to the society that the negro school consisted of thirty children, and in 1750 that it was going on with all desirable success. In 1748 a library was founded in Charleston by an association of seventeen young men, whose first object was to collect new pamphlets and magazines published in Great Britain, but in the course of a year embraced the purchase of books. After many delays and refusals, an act of incorporation was obtained in 1754. There is but one older library in this country.

Georgia.—The earliest effort to establish schools in Georgia was made by the Rev. George Whitefield. Before leaving England in 1737, he had projected an Orphan House, after the plan of that of Dr. Franké, at Halle, of which an account about that time appeared in English. His first visit to Savannah in 1738 satisfied him of the necessity of a charity school for poor and neglected children, and in the course of that year he returned to England to obtain his ordination as priest and collect funds for his educational enterprise. The trustees of the colony gave him five hundred acres of land upon which to erect his buildings. These were selected about ten miles out of Savannah, and on the 25th of March, 1740, he laid the first brick of the house, which he called Bethesda, or House of Mercy, and opened his school in temporary shelters with forty children. In the fall of the same year he made a collection and preaching tour in New England, during which he collected over £800 for his charity. After disasters by fire, etc., the Orphan House property was bequeathed to Selina, Countess of Huntingdon, in trust for the purposes originally designed, and subsequently incorporated for this purpose. On her death, and after the Revolution, the legislature transferred the property to thirteen trustees, to manage the estate and make regulations for an academy in the county of Chatham. Schools were established by the missionaries sent out by the Society for the Propagation of the Gospel at Savannah, Augusta, and Frederica, and by the Moravians and Huguenots in their respective settlements.

### RESULTS AT THE CLOSE OF OUR COLONIAL HISTORY.

The educational systems and provisions of the colonial period of the United States were, especially in its earlier portion, closely connected with the ecclesiastical systems of the colonies. Schools were maintained by individual youth trained up in very many cases, because it was a duty to prepare useful future members of the church, which in some of the colonies was also the state.

In three states, Massachusetts, Connecticut, and New Hampshire, it was very early made the legal duty of parents and towns to make provision for the education of youth. Elsewhere, such efforts as were made, aside from the natural desire of parents to afford their children such an education as was suitable to their rank in life, or such as would aid their subsequent progress and prosperity, were, generally speaking, put forth by clergymen, ecclesiastical bodies, or pious laymen, for colonial institutions for secondary education were not very numerous, including the town grammar schools of New England, and a small number of endowed or free schools. In these two classes of institutions, a small number of pupils were prepared to enter college. A far greater number of college students, more especially in the middle and southern states, were prepared by clergymen, who received each a small number of pupils into his family, as a means of securing some additional income. There were also a few private schools of considerable reputation and value.

In connection with these educational agencies, the small parochial and social libraries, and the two or three associations for the increase and dissemination of science, should also be referred to.

The institutions of superior education, established during the colonial period, were seven in number; namely, Harvard, William and Mary, Yale, Nassau Hall, Rutgers, Brown, and Columbia. From these came forth nearly all the liberally educated men of that day, though it was a custom of a few of the wealthiest families of the day to graduate their sons at a European university, Oxford or Cambridge being commonly selected. The colonial colleges, like the schools preparatory to them, were substantially church institutions, their pupils being the stock from which the clerical body was reinforced.

It was not until the very close of the colonial period that a few special or professional schools were established. A school of medicine, sufficiently entitled to the name, gave degrees in New York in 1769; a sort of theological seminary was founded in Pennsylvania in 1778; while the first law school only arose the year after the peace of 1783. Professorships, however, in these departments, had afforded a certain amount of instruction in all of them as part of the college course, long before; indeed, from the foundation of the earliest colleges.

Female education was comparatively neglected in the colonial period. Girls were taught housewifely duties far more assiduously than learning, and often depended upon home instruction for whatever education they received; neither the common schools nor those for secondary education affording or being designed to afford accommodation for them.

That special supplementary training which at the present day does so much to alleviate the misfortunes of the blind, the deaf and dumb, and the feeble minded, was quite unknown, nor was the idea entertained that such a training was practicable.

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## CHAPTER II.

### REVOLUTIONARY AND TRANSITIONAL PERIOD.

The immediate effects of the war of the Revolution were adverse, and, in certain aspects, disastrous to the interests of education. Dangers so great and imminent almost engrossed all thought and absorbed all exertion and resources. Children, indeed, were not left without the instruction of the family and the local elementary school, and they were, thank God, everywhere surrounded with the most stirring exhibitions of heroic patriotism and the self-sacrificing virtues. But too generally the elementary school and the teacher, never properly appreciated, gave way to more pressing and universally-felt necessities. Higher education for a time experienced a severe shock. The calls of patriotism withdrew many young men from the colleges and the preparatory schools, and prevented many more from resorting thither. The impoverishment of the country, and the demand for immediate action, compelled others to relinquish an extended course of professional study. In some cases the presence of armies caused a suspension of college instruction and the dispersion of faculty and students, and even converted the college buildings into barracks. But the action and influence of this period were not wholly adverse or disastrous to schools and higher education. The public mind was stimulated into greatly increased activity—now, for the first time, assuming a collective existence and national characteristics. The heart of the people was thoroughly penetrated by the spirit of self-sacrifice, in cheerfully bearing the burdens of society with diminished resources, and in repairing the waste and destruction of the war. The examples of wisdom and eloquence in council, and courage and heroism in the field, and of patient endurance of privation and hardship, and towering above all and outshining all, the colossal greatness and transparent purity of the character of Washington—these were lessons for the head and the heart of a young nation, which amply compensated for the partial and temporary suspension of schools. In the discussion and reconstruction of political society, in framing constitutions and organic legislation, and in the disposition of unsettled territory, the importance of the elementary school, the academy, and the college, was recognized and provided for.

Among the earliest to do justice to this great subject was Noah Webster, who, in a series of essays, first published in a New York paper, and copied extensively by the press in other parts of the country, and afterward embodied in a volume with other fugitive pieces, advocated a liberal policy by the national and local governments in favor of a broad system of education. "Here every class of people should know and love the laws. This knowledge should be diffused by means of schools and newspapers; and an attachment to the laws may be formed by early impression upon the mind. Two regulations are essential to the continuance of republican governments: 1. Such a distribution of lands and such principles of descent and alienation as shall give every citizen a power of acquiring what his industry merits. 2. Such a system of education as shall give every citizen an opportunity of acquiring knowledge, and fitting himself for places of trust." "Education should be the first care of a legislature; not merely the institution of schools, but the furnishing them with the best men for teachers. A good system of schools should be the first article in a code of political regulations; for it is much easier to introduce and establish an effectual system for preserving morals, than to correct by penal statutes the ill effects of a bad system. I am so fully persuaded of this, that I should almost adore that great man who shall change our practice and opinions, and make it respectable for the first and best men to superintend the education of youth." As specimens of the utterances of eminent public men on this subject, we cite the following:

"Promote, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened." GEORGE WASHINGTON.

"The wisdom and generosity of the legislature in making liberal appropriations in money for the benefit of schools, academies and colleges, is an equal honor to them and their constituents, a proof of their veneration for letters and science, and a portent of great and lasting good to North and South America, and to the world. Great is truth—great is liberty—great is humanity—and they must and will prevail." JOHN ADAMS.

"I look to the diffusion of light and education as the resources most to be relied on for ameliorating the condition, promoting the virtue, and advancing the happiness of man. And I do hope, in the present spirit of extending to the great mass of mankind the blessings of instruction, I see a prospect of great advancement in the happiness of the human race, and this may proceed to an indefinite, although not an infinite, degree. A system of general instruction, which shall reach every description of our citizens, from the richest to the poorest, as it was the earliest, so shall it be the latest of all the public concerns in which I shall permit myself to take an interest. Give it to us, in any shape, and receive for the inestimable boon the thanks of the young, and the blessings of the old, who are past all other services but prayers for the prosperity of their country, and blessings to those who promote it."
THOMAS JEFFERSON.

"Learned institutions ought to be the favorite objects with every free people; they throw that light over the public mind which is the best security against crafty and dangerous encroachments on the public liberty. They multiply the educated individuals, from among whom the people may elect a due portion of their public agents of every description, more especially of those who are to frame the laws: by the perspicuity, the consistency, and the stability, as well as by the justice and equal spirit of which, the great social purposes are to be answered."

JAMES MADISON.

"Moral, political and intellectual improvement, are duties assigned by the Author of our existence to social, no less than to individual man. For the fulfilment of these duties, governments are invested with power, and to the attainment of these ends, the exercise of this power is a duty sacred and indispensable." JOHN QUINCY ADAMS.

"For the purpose of promoting the happiness of the State, it is absolutely necessary that our government, which unites into one all the minds of the State, should possess in an eminent degree not only the understanding, the passions, and the will, but above all, the moral faculty and the conscience of an individual. Nothing can be politically right that is morally wrong; and no necessity can ever sanctify a law that is contrary to equity. Virtue is the soul of a Republic. To promote this, laws for the suppression of vice and immorality will be as ineffectual as the increase and enlargement of jails. There is but one method of preventing crime and of rendering a republican form of government durable; and that is, by disseminating the seeds of virtue and knowledge through every part of the State, by means of proper modes and places of education; and this can be done effectually only by the interference and aid of the legislature. I am so deeply impressed with this opinion, that were this the last evening of my life, I would not only say to the asylum of my ancestors and my beloved native country, with the patriot of Venice, '*Esto perpetua*,' but I would add, as the best proof of my affection for her, my parting advice to the guardians of her liberties, establish and support PUBLIC SCHOOLS in every part of the State." BENJAMIN RUSH.

"There is one object which I earnestly recommend to your notice and patronage—I mean our institutions for the education of youth. The importance of common schools is best estimated by the good effects of them where they most abound and are best regulated. Our ancestors have transmitted to us many excellent institutions, matured by the wisdom and experience of ages. Let them descend to posterity, accompanied with others, which, by promoting useful knowledge, and multiplying the blessings of social order, diffusing the influence of moral obligations, may be reputable to us, and beneficial to them." JOHN JAY.

"The first duty of government, and the surest evidence of good government, is the encouragement of education. A general diffusion of knowledge is the precursor and protector of republican institutions, and in it we must confide as the conservative power that will watch over our liberties and guard them against fraud, intrigue, corruption and violence. I consider the system of our Common Schools as the palladium of our freedom, for no reasonable apprehension can be entertained of its subversion, as long as the great body of the people are enlightened by education. To increase the funds, to extend the benefits, and to remedy the defects of this excellent system, is worthy of your most deliberate attention. I can not recommend in terms too strong and impressive, as munificent appropriations as the faculties of the State will authorize for all establishments connected with the interests of education, the exaltation of literature and science, and the improvement of the human mind."

DE WITT CLINTON.

"The parent who sends his son into the world uneducated, defrauds the community of a lawful citizen, and bequeaths to it a nuisance." CHANCELLOR KENT.

In the discussions which have taken place in the press and in the halls of legislation on the subject, the experience of the New England States is constantly cited as an irrefutable argument in favor of public schools and universal education. The character and value of this example are admirably set forth by Daniel Webster:

"In this particular, New England may be allowed to claim, I think, a merit of a peculiar character. She early adopted and has constantly maintained the principle, that it is the undoubted right, and the bounden duty of government, to provide for the instruction of all youth. That which is elsewhere left to chance, or to charity, we secure by law. For the purpose of public instruction, we hold every man subject to taxation in proportion to his property, and we look not to the question, whether he himself have, or have not, children to be benefited by the education for which he pays. We regard it as a wise and liberal system of police, by which property, and life, and the peace of society are secured. We seek to prevent in some measure the extension of the penal code, by inspiring a salutary and conservative principle of virtue and of knowledge in an early age. We hope to excite a feeling of respectability, and a sense of character, by enlarging the capacity, and increasing the sphere of intellectual enjoyment. By general instruction, we seek, as far as possible, to purify the whole moral atmosphere; to keep good sentiments uppermost, and to turn the strong current of feeling and opinion, as well as the censures of the law, and the denunciations of religion, against immorality and crime. We hope for a security, beyond the law, and above the law, in the prevalence of enlightened and well-principled moral sentiment. We hope to continue and prolong the time when, in the villages and farmhouses of New England, there may be undisturbed sleep within unbarred doors. And knowing that our government rests directly on the public will, that we may preserve it, we endeavor to give a safe and proper direction to that public will. We do not, indeed, expect all men to be philosophers or statesmen; but we confidently trust, and our expectation of the duration of our system of government rests on that trust, that by the diffusion of general knowledge and good and virtuous sentiments, the political fabric may be secure, as well against open violence and overthrow, as against the slow but sure undermining of licentiousness."

The action of Congress, and of the early constitutional conventions of the several states, shows how nobly the public mind responded to these appeals.

On the 17th of May, 1784, Mr. Jefferson, as chairman of a committee for that purpose, introduced into the old Congress an ordinance respecting the disposition of the public lands; but this contained no reference to schools or education. On the 4th of March, 1785, another ordinance was introduced—by whom does not appear on the journal—and on the 16th of the same month was recommitted to a committee consisting of Pierce Long of New Hampshire, Rufus King of Massachusetts, David Howell of Rhode Island, Wm. S. Johnson of Connecticut, R. R. Livingston of New York, Charles Stewart of New Jersey, Joseph Gardner of Pennsylvania, John Henry of Maryland, William Grayson of Virginia, Hugh Williamson of North Carolina, John Bull of South Carolina, and William Houston of Georgia. On the 14th of April following, this committee reported the ordinance—by whom drawn up no clue is given—which, after being perfected, was passed the 20th of May following, and became the foundation of the existing land system of the United States.

By one of its provisions, the sixteenth section of every township was reserved "*for the maintenance of public schools;*" or, in other words, one section out of the thirty-six composing each township. The same provision was incorporated in the large land sale, in 1786, to the Ohio Company, and the following year in Judge Symmes' purchase. The celebrated ordinance of 1787, for the government of the territory north-west of the River Ohio, and which confirmed the provisions of the land ordinance of 1785, provides further, that, "RELIGION, MORALITY and KNOWLEDGE being necessary to good government and the happiness of mankind, SCHOOLS, AND THE MEANS OF EDUCATION, SHALL BE FOREVER ENCOURAGED." From that day to the present, this noble policy has been confirmed and extended, till its blessings now reach even the distant shores of the Pacific, and FIFTY MILLIONS OF ACRES of the public domain have been set apart and consecrated to the high and ennobling purposes of education, together with five per cent. of the net proceeds of the sales of all public lands in each of the states and territories in which they are situated.

During this period individual beneficence and associated enterprise began to be directed to the building up, furnishing, and maintaining libraries, colleges, academies, and scientific institutions. Societies for the promotion of science and literature, and schools for professional training, were founded and incorporated, and men of even moderate fortune began to feel the luxury of doing good, and to see that a wise endowment for the relief of suffering, the diffusion of knowledge, the discovery of the laws of nature, the application of the principles of science to the useful arts, the conservation of good morals, and the spread of religious truth, is, in the best sense of the term, a good investment—an investment productive of the greatest amount of the highest good both to the donor and his posterity, and which makes the residue of the property from which it is taken both more secure and more valuable.

## CHAPTER III.

### STATE AND NATIONAL ACTION.

#### INTRODUCTION.

We shall not attempt to follow out in separate channels the action of the National and State governments, which together constitute the legislative power of the United States, both of which have been exerted on the education and educational institutions of the whole country; but confine ourselves mainly to an exposition of the State systems of public instruction, with an incidental notice of such national institutions as belong to each department treated of. Before entering on this exposition, we give from the most reliable cotemporaneous authority (*A Historical and Geographical Account of the United States. By Noah Webster, Jr.*, 1804), a comprehensive survey of the state of learning and of educational institutions in the whole country at the opening of this century.

### I. EDUCATIONAL INSTITUTIONS ABOUT 1800.

#### NEW HAMPSHIRE.

*Of the State of Learning.*—An old law of the colony (1719), directed every town, containing one hundred families, to provide a grammar school; in which also was to be taught reading, writing and arithmetic. This law was not well executed. Since the revolution, a law of the state has directed the maintenance of schools in the several towns under certain penalties. There are also social libraries; and newspapers circulate in almost all parts of the state.

*Of the Academies.*—At Exeter an academy, founded by John Phillips, Esq., and called after his name, was incorporated in 1781. At Atkinson, an academy founded by Nathaniel Peabody, Esq., was incorporated in 1790. Academies are also found at Amherst, Charlestown and Concord.

*Of Dartmouth College.*—At Hanover, in Grafton county, is a college founded by Dr. Wheelock in 1769, with a special view to the instruction of young Indians. Although this object has in a great measure failed, the institution is prosperous and highly useful. The number of students is seldom less than one hundred and fifty; its funds, consisting of new lands, are increasing in value; its library and apparatus are tolerably complete; its situation is pleasant and advantageous. It takes its name from a principal benefactor, the Earl of Dartmouth.

#### VERMONT.

*Of the State of Learning.*—Learning receives from the people of Vermont all the encouragement that can be expected from an agricultural people in a new settlement. Schools for common education are planted in every part of the state; and two colleges are established, one at Middlebury, the other at Burlington, in which are taught classical learning, and the higher branches of mathematics, philosophy, and other sciences.

#### MASSACHUSETTS.

*Of the State of Learning.*—In Massachusetts the principal institutions for science are the University of Cambridge, and the college at Williamstown. The university of Cambridge was founded in 1638—it is well endowed—is furnished with professors of the several sciences—a large library and apparatus—and contains usually from one hundred and forty to two hundred students. Williams college, in Williamstown, founded in 1793, is in a thriving state. Academies are established in various parts of the state, in which are taught the liberal sciences, as well as the languages. The laws of the state require a school to be kept in every town, having fifty householders, and a grammar school in every town having two hundred families. And although the laws are not rigidly obeyed, still most of the children in the state have access to a school.

#### MAINE—PART OF MASSACHUSETTS TILL 1822.

*Of the State of Learning and Religion.*—The laws of Massachusetts direct that a school shall be kept in each town, and lands are retained, as public lots, for the support of schools and the gospel ministry. These beneficial institutions are enjoyed in the old settlements; but a great part of the district, being lately settled, is not well supplied with schools.

#### RHODE ISLAND.

*Of the State of Learning.*—There is a college at Providence, founded by the Baptists, containing forty-eight rooms for students, and eight rooms for public uses. It has a library of near three thousand volumes—and an apparatus for experiments in philosophy. It is furnished with a president and suitable instructors for the students who are usually about fifty in number. In the large towns, and in some others, there are private schools for teaching the common branches of learning.

CONNECTICUT.

*Of the State of Learning.*—Soon after the settlement of Connecticut, the General Court passed laws directing schools to be kept in every village, and providing funds to encourage them. Every town or village containing a certain number of families, was directed to maintain a school, and empowered to draw from the treasury of the state, a sum equal to one five-hundredth part of the amount of the property of the town, as assessed in the grand list. By means of this provision, common schools have been kept in all parts of the state, and every person is taught to read, write, and keep accounts. By the sale of the western reserve in 1795, still more liberal and permanent funds were provided for the support of schools. In winters the larger children are instructed by men; in summer, small children attend the schools, and are taught by women; in general the instructors are selected from persons of good families and reputation.

*Of Yale College.*—Yale College, so called, from a principal benefactor, was founded in the year 1700 at Killingworth, but fixed at New Haven in 1716. It consists of three colleges, each containing thirty-two rooms, a chapel and museum—has a library of about two thousand volumes, and a philosophical apparatus. Its funds are ample, and from thirty to fifty students are annually graduated at the public commencement in September. It is under the direction of trustees, consisting of eleven clergymen. and eight laymen. The vacancies among the clerical members are supplied by the board of trustees. The lay members are the governor, lieutenant-governor, and six senior members of the council of the state, or upper house.

*Of Academies and Grammar Schools.*—By law, a grammar school may be established in any town in the state, by a vote of the inhabitants in legal meeting; and many academies are established and maintained by private funds. In these are taught not only the primary branches of learning, but geography, grammar, the languages, and higher branches of mathematics. There are also academies for young ladies, in which are taught the additional branches of needle-work, drawing, and embroidery. Among the academies of the first reputation are, one in Plainfield, and the Bacon academy in Colchester, whose funds amount to about thirty-five thousand dollars. The most distinguished schools for young ladies are, Union school in New Haven, and one in Litchfield.

NEW YORK.

*Of the State of Learning.*—A college was founded in the city of New York in 1754, and incorporated by charter from the king. After the revolution, the legislature instituted a university consisting of a number of regents, whose powers extend to the superintendence of colleges, academies and schools, throughout the state. They are authorized to found colleges and academies, confer degrees, visit all seminaries of learning, and make regulations for their government.

*Of Columbia and Union Colleges.*—By the act of the Legislature in 1787, founding the university of the state, the college in New York received the name of *Columbia*, and all the privileges and powers, derived from its charter, were confirmed. It is under the government of twenty-four trustees, and has considerable funds. Its instructors are a president and professors of the principal sciences. The building is of stone, three stories high, and containing forty-eight apartments. The college is furnished with a chapel, a library, museum, and philosophical apparatus. Union college was founded at Schenectady in 1795, and is in a prosperous condition.

*Of Academies and Schools.*—Several respectable academies are established in different parts of the state, in which are taught the learned languages, geography, grammar, and mathematics. Until since the revolution, common schools received no encouragement from the public treasury, or the laws. But in 1795, a law of the state appropriated a large sum of money for erecting school-houses, and paying teachers, the beneficial effects of which are visible. Hitherto, however, the rudimentary instruction of the laboring people has not been general.

NEW JERSEY.

*Of the State of Learning.*—The education of youth in New Jersey depends on the voluntary contributions of individuals, and therefore is neglected by some classes of the people. In the more populous towns and villages are academies and schools of high reputation. The college at Princeton, called Nassau Hall, is a seminary of distinguished reputation, and from thirty to forty students are annually graduated.

PENNSYLVANIA.

*Of the State of Learning.*—In Pennsylvania is one university, the seat of which is Philadelphia; a college at Carlisle, and another at Lancaster. There are numerous academies and schools in Philadelphia and other large towns. The legislature have reserved sixty thousand acres of land as a fund for supporting public schools. The Moravian academies at Bethlehem and Nazareth, are noted for strict discipline.

DELAWARE.

*Of the Schools.*—There are private schools in this state, and especially in Wilmington. In 1796, the legislature passed an act for creating a fund for the support of public schools. There is no college in the state, but an academy at Newark, a few miles from Wilmington.

MARYLAND.

*Of the Literary Institutions.*—The principal institutions for the education of youth are, Washington academy, in Somerset county, instituted in 1779; Washington college at Chester, founded in 1782; St. Johns college at Annapolis, founded in 1784; a college at Georgetown, instituted by the Catholics; and Cokesbury college in Harford County, instituted by the methodists in 1785. There are private schools in many places; and private tutors in families; and many young men are sent for their education either to Europe, or the northern states.

VIRGINIA.

*Seminaries of Learning.*—The college in Williamsburg was founded during the reign of William and Mary, and called by their names. It was endowed by them with twenty thousand acres of land, and the proceeds of a duty of one penny on the pound of tobacco exported—with a duty on skins and furs exported, and liquors imported. It is under the government of twenty visitors, a president and professors in the most important branches of science. There is also a college in Prince Edward, and academies in the principal towns, as well as numerous schools in other parts of the state.

NORTH CAROLINA.

*Of the State of Learning.*—In 1789 the legislature passed an act incorporating a number of persons as trustees of a university to be established, and funds were supplied for the purpose of erecting buildings. There is an academy of Warrenton, and a few others in the state; but the education of all classes of people is not general. In 1803, however, the legislature passed an act for the establishment of public schools.

SOUTH CAROLINA.

*Of the Seminaries of Learning.*—Gentlemen of property have been accustomed to send their sons and daughters to England for an education. Some of them send their sons to one of the colleges in the northern states. There are several institutions in the States called colleges and academies—a college in Charleston, one at Winnsborough, in Camden district, one at Cambridge, and one at Beaufort, with considerable funds. There are several academies and schools in Charleston, Beaufort, and other parts of the state. The *South Carolina College* was incorporated in 1801, with an appropriation of fifty thousand dollars for erecting buildings in Columbia, and six thousand dollars yearly for instructors.

GEORGIA.

*Of the Literary Institutions.*—The legislature of Georgia has founded and endowed a college at Louisville. There are also some schools in the state. A law of the state has incorporated a number of literary gentlemen, for the purpose of establishing and superintending seminaries of learning—fifty thousand acres of land are appropriated for funds, for this university—and a sum of money in each county for maintaining an academy. The funds destined by Mr. Whitfield to maintain an orphan house, and by him bequeathed to the countess of Huntingdon, in trust, are vested in commissioners to support a college.

KENTUCKY.

*Of the State of Learning.*—Provision has been made by law for founding and maintaining a college, and schools are established in different parts of the state.

TENNESSEE.

*Of Learning.*—Several schools are established in this state, and by law provision is made for three colleges. There is also a society for promoting useful knowledge.

Before entering on a systematic survey of the development of education in its different departments of elementary, secondary, superior, professional and supplementary instruction, we give in the following table the gradual growth of the country from 13 to 38 States, with their population in 1870.

TABLE I.—*Historical and statistical data of the United States.*

[Compiled from Report of the Commissioner of the Land Office for 1867.]

| States and Territories. | Act organizing Territory. | | | Act admitting State. | | | Area in sq. miles. | Populat'n in 1860.† |
|---|---|---|---|---|---|---|---|---|
| | U. S. Statutes. | Vol. | Page. | U. S. Statutes. | Vol. | Page. | | |
| *Original States.* | | | | | | | | |
| New Hampshire | | | | | | | 9, 280 | 326, 073 |
| Massachusetts | | | | | | | 7, 800 | 1, 231, 066 |
| Rhode Island | | | | | | | 1, 306 | 174, 620 |
| Connecticut | | | | | | | 4, 750 | 460, 147 |
| New York | | | | | | | 47, 000 | 3, 880, 735 |
| New Jersey | | | | | | | 8, 320 | 672, 035 |
| Pennsylvania | | | | | | | 46, 000 | 2, 906, 115 |
| Delaware | | | | | | | 2, 120 | 112, 216 |
| Maryland | | | | | | | 11, 124 | 687, 049 |
| Virginia—East and West. | | | | | | | 61, 352 | 1, 596, 318 |
| North Carolina | | | | | | | 50, 704 | 992, 622 |
| South Carolina | | | | | | | 34, 000 | 703, 708 |
| Georgia | | | | | | | 58, 000 | 1, 057, 286 |
| *States admitted.* | | | | | | | | |
| Kentucky | | | | Feb. 4, 1791 | 1 | 189 | 37, 680 | 1, 155, 684 |
| Vermont | | | | Feb. 18, 1791 | 1 | 191 | *10, 212 | 315, 098 |
| Tennessee | | | | June 1, 1796 | 1 | 491 | 45, 600 | 1, 109, 801 |
| Ohio | Ord'ce of 1787 | | | Apr. 30, 1802 | 2 | 173 | 39, 964 | 2, 339, 502 |
| Louisiana | Mar. 3, 1805 | 2 | 331 | Apr. 8, 1812 | 2 | 701 | *41, 346 | 708, 002 |
| Indiana | May 7, 1800 | 2 | 58 | Dec. 11, 1814 | 3 | 399 | 33, 809 | 1, 350, 428 |
| Mississippi | Apr. 7, 1798 | 1 | 549 | Dec. 10, 1817 | 3 | 672 | 47, 156 | 791, 305 |
| Illinois | Feb. 3, 1809 | 2 | 514 | Dec. 3, 1818 | 3 | 536 | *55, 410 | 1, 711, 951 |
| Alabama | Mar. 3, 1817 | 3 | 371 | Dec. 14, 1819 | 3 | 608 | 50, 722 | 964, 201 |
| Maine | | | | Mar. 3, 1820 | 3 | 544 | *35, 000 | 628, 279 |
| Missouri | June 4, 1812 | 2 | 743 | Mar. 2, 1821 | 3 | 645 | *65, 350 | 1, 182, 012 |
| Arkansas | Mar. 2, 1819 | 3 | 493 | June 15, 1836 | 5 | 50 | 52, 198 | 435, 450 |
| Michigan | Jan. 11, 1805 | 2 | 309 | Jan. 26, 1837 | 5 | 144 | *56, 451 | 749, 113 |
| Florida | Mar. 30, 1822 | 3 | 654 | Mar. 3, 1845 | 5 | 742 | 59, 268 | 140, 425 |
| Iowa | June 12, 1838 | 5 | 235 | do | 5 | 742 | 55, 045 | 674, 948 |
| Texas | | | | Dec. 29, 1845 | 9 | 108 | *274, 356 | 604, 215 |
| Wisconsin | Apr. 20, 1836 | 5 | 10 | Mar. 3, 1847 | 9 | 178 | 53, 924 | 775, 881 |
| California | | | | Sept. 9, 1850 | 9 | 452 | *188, 981 | 305, 439 |
| Minnesota | Mar. 3, 1849 | 9 | 403 | Feb. 26, 1857 | 11 | 166 | 83, 531 | 173, 855 |
| Oregon | Aug. 14, 1848 | 9 | 323 | Feb. 14, 1859 | 11 | 383 | 95, 274 | 52, 465 |
| Kansas | May 30, 1854 | 10 | 277 | Jan. 29, 1861 | 12 | 126 | 81, 318 | 107, 206 |
| West Virginia | | | | Dec. 31, 1862 | 12 | 633 | 23, 000 | |
| Nevada | Mar. 2, 1861 | 12 | 209 | Mar. 21, 1864 | 13 | 30 | 112, 090 | ‡6, 857 |
| Colorado | Feb. 28, 1861 | 12 | 172 | | 13 | 32 | *104, 500 | ‡34, 277 |
| Nebraska | May 30, 1854 | 10 | 277 | Mar. 1, 1867 | 13 | 47 | 75, 995 | 28, 841 |
| *Territories.* | | | | | | | | |
| New Mexico | Sept. 9, 1850 | 9 | 446 | | | | 121, 201 | §360, 000 (New Mexico to Indian Territory) |
| Utah | do | 9 | 453 | | | | 88, 056 | |
| Washington | Mar. 2, 1853 | 10 | 172 | | | | 69, 994 | |
| Dakota | Mar. 2, 1861 | 12 | 239 | | | | 240, 597 | |
| Arizona | Feb. 24, 1863 | 12 | 664 | | | | 113, 916 | |
| Idaho | Mar. 3, 1863 | 12 | 808 | | | | 90, 932 | |
| Montana | May 26, 1864 | 13 | 85 | | | | 143, 776 | |
| Indian Territory | | | | | | | 68, 991 | |
| Dist. of Columbia | July 16, 1790<br>Mar. 3, 1791 | 1<br>1 | 130<br>214 | | | | ‖10 m. sq. | ¶126, 990 |
| Russian purchase | | | | | | | 577, 390 | 70, 000 |

* Area taken from geographical authorities and not from public surveys.

† Total population in 1860 was 31,500,000; estimated in 1867 to be 38,500,000.

‡ To the white population in Nevada should be added 10,507 Indians; and in Colorado, 2,261 Indians.

§ As estimated January 1, 1865.

‖ That portion of District of Columbia south of the Potomac river was retroceded to Virginia July 9, 1846, (Stat. vol. 6, p. 35.)

¶ By census of 1867.

## II. SCHOOL-HOUSES, STUDIES, BOOKS, AND TEACHERS AS THEY WERE.

To understand the real progress which has been made in the organization, administration, and instruction of institutions of learning in this country, and at the same time to appreciate the importance of many agencies and means of popular education besides schools, books and teachers, we must, as far as we can, look into the schools themselves, as they were fifty and sixty years ago, and realize the circumstances under which some of the noblest characters of our history have been developed. As a contribution to our knowledge of the early history of education in the United States, we bring together the testimony of several eminent men who were pupils or teachers in these schools, and who assisted in various ways in achieving their improvement.

### LETTER FROM NOAH WEBSTER, LL.D.

"NEW HAVEN, March 10th, 1840.

"MR. BARNARD: *Dear Sir*—You desire me to give you some information as to the mode of instruction in common schools when I was young, or before the Revolution. I believe you to be better acquainted with the methods of managing common schools, at the present time, than I am; and I am not able to institute a very exact comparison between the old modes and the present. From what I know of the present schools in the country, I believe the principal difference between the schools of former times and at present consists in the books and instruments used in the modern schools.

"When I was young, the books used were chiefly or wholly Dilworth's Spelling Books, the Psalter, Testament and Bible. No geography was studied before the publication of Dr. Morse's small books on that subject, about the year 1786 or 1787. No history was read, as far as my knowledge extends, for there was no abridged history of the United States. Except the books above mentioned, no book for reading was used before the publication of the Third Part of my Institute, in 1785. In some of the early editions of that book, I introduced short notices of the geography and history of the United States, and these led to more enlarged descriptions of the country. In 1788, at the request of Dr. Morse, I wrote an account of the transactions in the United States, after the Revolution; which account fills nearly twenty pages in the first volume of his octavo editions.

"Before the Revolution, and for some years after, no slates were used in common schools; all writing and the operations in arithmetic were on paper. The teacher wrote the copies and gave the sums in arithmetic; few or none of the pupils having any books as a guide. Such was the condition of the schools in which I received my early education.

"The introduction of my Spelling Book, first published in 1783, produced a great change in the department of spelling; and from the information I can gain, spelling was taught with more care and accuracy for twenty years or more after that period, than it has been since the introduction of multiplied books and studies.*

"No English grammar was generally taught in common schools when I was young, except that in Dilworth, and that to no good purpose. In short, the instruction in schools was very imperfect, in every branch; and if I am not misinformed, it is so to this day, in many branches. Indeed there is danger of running from one extreme to another, and instead of having too few books in our schools, we shall have too many.

"I am, sir, with much respect, your friend and obedient servant, N. WEBSTER."

Dr. Webster, in an essay published in a New York paper in 1788, "On the Education of Youth in America," and in another essay published in Hartford, Ct., in 1790, "On Property, Government, Education, Religion, Agriculture, etc., in the United States,"† while setting forth some of the cardinal doctrines of American education as now held, throws light on the condition of schools and colleges in different parts of the country at that date.

"The first error that I would mention is a

* "The general use of my Spelling Book in the United States has had a most extensive effect in correcting the pronunciation of words, and giving uniformity to the language. Of this change, the present generation can have a very imperfect idea."

† These essays were afterwards collected with others in a volume entitled "A Collection of Essays and Fugitive Writings, etc." By Noah Webster, Jr. Boston: 1790.

too general attention to the dead languages, with a neglect of our own. . . . This neglect is so general that there is scarcely an institution to be found in the country where the English tongue is taught regularly from its elements to its pure and regular construction in prose and verse. Perhaps in most schools boys are taught the definition of the parts of speech, and a few hard names which they do not understand, and which the teacher seldom attempts to explain; this is called learning grammar. . . . The principles of any science afford pleasure to the student who comprehends them. In order to render the study of language agreeable, the distinctions between words should be illustrated by the difference in visible objects. Examples should be presented to the senses which are the inlets of all our knowledge.

"Another error which is frequent in America, is that a master undertakes to teach many different branches in the same school. In new settlements, where the people are poor, and live in scattered situations, the practice is often unavoidable. But in populous towns it must be considered as a defective plan of education. For suppose the teacher to be equally master of all the branches which he attempts to teach, which seldom happens, yet his attention must be distracted with a multiplicity of objects, and consequently painful to himself, and not useful to his pupils. Add to this the continual interruptions which the students of one branch suffer from those of another, which must retard the progress of the whole school. It is a much more eligible plan to appropriate an apartment to each branch of education, with a teacher who makes that branch his sole employment. . . . Indeed what is now called a liberal education disqualifies a man for business. Habits are formed in youth and by practice; and as business is in some measure mechanical, every person should be exercised in his employment in an early period of life, that his habits may be formed by the time his apprenticeship expires. An education in a university interferes with the forming of these habits, and perhaps forms opposite habits; the mind may contract a fondness for ease, for pleasure, or for books, which no efforts can overcome. An academic education, which should furnish the youth with some ideas of men and things, and leave time for an apprenticeship before the age of twenty-one years, would be the most eligible for young men who are designed for active employments.

* * * * * *

"But the principal defect in our plan of education in America is the want of good teachers in the academies and common schools. By good teachers I mean men of unblemished reputation, and possessed of abilities competent to their station. That a man should be master of what he undertakes to teach is a point that will not be disputed; and yet it is certain that abilities are often dispensed with, either through inattention or fear of expense. To those who employ ignorant men to instruct their children, let me say, it is better for youth to have no education than to have a bad one; for it is more difficult to eradicate habits than to impress new ideas. The tender shrub is easily bent to any figure; but the tree which has acquired its full growth resists all impressions. Yet abilities are not the sole requisites. The instructors of youth ought, of all men, to be the most prudent, accomplished, agreeable, and respectable. What avail a man's parts, if, while he is 'the wisest and brightest,' he is the 'meanest of mankind?' The pernicious effects of bad example on the minds of youth will probably be acknowledged; but, with a view to improvement, it is indispensably necessary that the teachers should possess good breeding and agreeable manners. In order to give full effect to instructions it is requisite that they should proceed from a man who is loved and respected. But a low-bred clown or morose tyrant can command neither love nor respect; and that pupil who has no motive for application to books but the fear of the rod, will not make a scholar."

LETTER FROM REV. HEMAN HUMPHREY, D.D.

"PITTSFIELD, Dec. 12th, 1860.

"HON. HENRY BARNARD: *Dear Sir*—I am glad to hear from you, still engaged in the educational cause, and that you are intending to 'give a picturesque survey of the progress of our common schools, their equipment, studies and character.' If my early recollections and experience will give you any little aid, I shall esteem myself happy in affording it.

"The first school I remember was kept a few weeks by a maiden lady, called Miss Faithy, in a barn. I was very young, as were most of the children. What I learned then, if any thing, I have forgotten. This was in the summer, of course. The next was a school, so called, kept a month or two by a neighbor of ours, who was the best *trout fisher*, with his horse-hair line, in all those parts. He wrote a fair hand, as I remember, on birch bark. What he taught us, but to say *tue* and *due*, has escaped my recollection. We had no school-house then in our district, and we met as much for play as any thing, where we could find shelter. The next winter, another neighbor took us a few weeks into one of the rooms of his own house, where every thing but learning was going on. His speech bewrayed him of Rhode Island origin, and whatever he knew, he certainly could never have had much if any chance of being whipped in school when he was a boy. I remember his tremendous *stamp* when we got noisy in school-time, and that is all. This, however, is not a fair sample of school accommodations in my boyhood; and I had a better chance for two or three winters afterward.

"School Houses.—Most of the other districts in the town had school-houses, but not all. The first winter that I kept school myself, was in a room next to the kitchen in a small private house. Some of the school-houses were better than others; but none of them in that or the adjoining towns were convenient or even comfortable. They were rather *juvenile penitentiaries*, than attractive accommodations for study. They were too small, and low from the ceiling to the floor, and the calculation of the builders seemed to have been, to decide into how small a space the children could be crowded, from the fire-place till the room was well packed. Not unfrequently sixty or seventy scholars were daily shut up six hours, where there was hardly room for thirty. The school-houses were square, with a very narrow entry, and a large fire-place on the side near the door. There were no stoves then. They were generally roughly clapboarded, but never painted. They had writing-desks, or rather, long boards for writing, on two or three sides, next to the wall. The benches were all loose; some of them boards, with slabs from the saw-mill, standing on four legs, two at each end. Some were a little lower than the rest, but many of the smaller children had to sit all day with their legs dangling between the bench and the floor. Poor little things! nodding and trying to keep their balance on the slabs, without any backs to lean against, how I pity them to this day. In the coldest weather, it was hard to tell which was the most difficult, to keep from roasting or freezing. For those nearest to the fire it was sweltering hot, while the ink was freezing in the pens on the back side of the room. '*Master*, I am too hot'—'Master, may I go to the fire?' That was the style of address in those days, and we did our best to be *masters*, anyhow.

"All the school-houses that I remember stood close by the travelled road, without any play-grounds or enclosures whatever. If there were any shade trees planted, or left of spontaneous growth, I have forgotten them. And in most cases, there were no outside accommodations, even the most necessary for a moment's occasion. I now marvel at it, but so it was. In that respect, certainly, the days of the children are better than the days of their fathers were.

"For the most part, the winter schools were miserably supplied with wood. I kept school myself in three towns, and in but one of the schools was there any wood-shed whatever; and no wood was got up and seasoned in summer against winter. Most of what we used was standing in the forests when the school began, and was cut and brought sled length by the farmers in proportion to the number of scholars which they sent. Not exactly that, either; for sometimes, when we went to the school-house in a cold morning, there was *no wood* there. Somebody had neglected to bring his load, and we were obliged to adjourn over to the next day. In many cases, the understanding was, that the larger boys must cut the wood as it was wanted. It always lay in the snow, and sometimes the boys were sent to dig it out in school-time, and bring it in, all wet and green as it was, to keep us from freezing. That was the fuel to make fires with in the morning, when the thermometer was below zero, and how the little children cried with the cold, when they came almost frozen, and found no fire burning; nothing but one or two boys blowing and keeping themselves warm as well as they could, by exercise, in trying to kindle it. Such were our school-houses and their disaccommodations.

"Branches Taught in the Schools.—They were reading, spelling, and writing, besides the A B C's to children scarcely four years old, who ought to have been at home with their mothers. They were called up twice a day by the master pointing with his penknife 'What's that?' 'A.' 'What's that?' 'D.' 'No, it's B.' 'What's that?' 'N.' 'No, you careless boy, it's C;' and so down to *ezand*. 'Go to your seat, you will never learn your lesson in the world, at this rate.' Our school-books were the Bible, 'Webster's Spelling Book,' and 'Third Part,' mainly. One or two others were found in some schools for the reading classes. Grammar was hardly taught at all in any of them, and that little was confined almost entirely to committing and reciting the rules. Parsing was one of the occult sciences in my day. We had some few lessons in geography, by questions and answers, but no maps, no globes; and as for *black-boards*, such a thing was never thought of till long after. Children's reading and picture books, we had none; the fables in Webster's Spelling Book came nearest to it. Arithmetic was hardly taught at all in the day schools. As a substitute, there were some evening schools in most of the districts. Spelling was one of the leading daily exercises in all the classes, and it was better, a good deal, I think, than it is now.

"The winter schools were commonly kept about three months; in some favored districts *four*, but rarely as long. As none of what are now called the higher branches were taught beyond the merest elements, parents generally thought that three or four months was enough. There were no winter *select* schools for the young above the age of sixteen or seventeen, as I remember, till after I retired from the profession, such as it then was. There may have been here and there an academy, in some parts of the state; but not one within the range of my acquaintance.

"Our Spring Exhibitions.—At the close of the winter schools we had what we used to call our *Quarter-days*, when the schools came together in the meeting-house, with a large congregation of parents and friends. The public exercises were reading, spelling, and speaking single pieces, and dialogues. Some of the dialogues we wrote ourselves, for our own schools. Most of them were certainly very flat; but they brought down the house, and answered the purpose as well as any we could pick up. We thought then, as I think now, that those quarter-days were of great advantage to the schools. The anticipation of them kept up an interest all winter, and stimulated both teachers and scholars to do their best in the way of preparation. As the time approached, we had evening schools for reading and rehearsing the dialogues, so as to be sure not to fall behind in the exhibitions. None of our college commencements are now looked forward to with greater interest than were those vernal anniversaries.

"Another thing that helped us a good deal was the occasional afternoon visits of the parents and other friends of the schools. They came in by invitation, or whenever they chose, and their visits always did us good.

"Still another practice we found to be quite stimulating and useful. We had a mutual understanding that, without giving any notice, any teacher might dismiss his own school for an afternoon, and, taking along with him some of the older boys, call in to see how his brother teacher got along in the next or some other district. The arrangement worked well. We made speeches, complimented one another as politely as circumstances would allow, and went home resolved not to fall behind the best of them.

"In the school, we made up our minds to be masters, in *fact* as well as in name. Though of late years I have not had very good advantages for making the comparison, I believe the schools were quite as well governed sixty years ago as they are now. Among other things which we did to maintain our authority, was to go out now and then and have a snowball skirmish with the boys, and though we commonly got beat, nothing we could do was more effectual.

"*Corporal* punishments, I believe, were sparingly resorted to in most of our schools. Though I myself believed in Solomon fully, I never flogged but one scholar in my life, though I shook the mischief out of a great many. I think Sam was of the opinion, in the premises, that the rod was laid on rather smartly, for I understood he promised, some day, to pay me in kind, which, however, I suppose he never found it quite convenient to undertake.

"We schoolmasters within convenient distances used to meet in the winter evenings for mutual improvement, which, to own the truth, we needed a good deal. Our regular exercises were reading for criticisms, reporting how we were getting along, and conversing upon the best method of managing our schools. This was very profitable, as we thought, to us all.

"In those ancient times, it was an almost universal custom in the rural towns of Connecticut, for the teachers to *board round*, and upon the whole I liked it. It was a good school for us. By going into all the families we learned a great deal. We were looked upon as having more in our heads than we could fairly claim, and they always kept us on the best they had. It is true, the cooking was not always the best, nor sheets always so clean as to guard against infection; and if, perchance, it sometimes broke out, we knew how to cure it.

"Our wages were generally screwed down to the lowest notch by the school committees, under the instruction of the districts. For my first campaign I received *seven* dollars a month and board; for the next, *nine;* for the third, *ten;* and I think I never went above thirteen till quite the last of my teaching before I went to college. As I had some reputation in that line, I suppose I was as well paid as my brethren.

"With regard to the summer schools of that period, I have very little to say. They were kept by females upon very low wages, about as much a week as they could earn in families by spinning or weaving. They took good care of the little children, and taught them as well as they could.

"As we had no grammar schools in which the languages were taught, we most of us fitted for college with our ministers, who, though not very fresh from their classics, did what they could to help us.

"Finally, you ask me whether there were any schools for young ladies in those old times? There may possibly have been in two or three of the largest towns, but the only one of which I had any knowledge was in Litchfield, kept by Miss Pierce, and I am not quite sure that her school was established as early as your question contemplates.

"These, dear sir, are some of my old remembrances, which you may make such use of as you please.

"Respectfully yours,

"H. HUMPHREY."

LETTER FROM HON. JOSEPH T. BUCKINGHAM.

"CAMBRIDGE, Dec. 10th, 1860.

"HENRY BARNARD, ESQ.: *My Dear Sir*—I cheerfully comply with your request to give you some account of the schools and the educational books that were in use about the close of the last century. I never had the privilege of attending any higher institution of learning than the common district schools of Connecticut, in the town of Windham; but I have no doubt that those of that town were a fair type of many others, probably most of them, except such as were kept in the larger towns or thickly populated villages.

"According to the best of my remembrance, my school-days began in the spring of 1783. The school to which I was admitted was kept by a lady, and, like most of the district schools, was kept only for the younger pupils, and was open for two months during the summer season. The upper class in the school was formed entirely of females—such as could read in the Bible. The lower classes read in spelling books and the New England Primer. The spelling books, of which there were not, probably, more than three or four in the school, I believe were all by Dilworth, and were much worn and defaced, having been a sort of heir-loom in the families of the pupils. The teacher of this school was the daughter of the minister of the parish. She kept a rod hanging on the wall behind her chair and a ferule on the table by her side; but I do not recollect that she used either of them. The girls who constituted the first class were required, every Monday morning, to repeat the text or texts of the preceding day's discourse, stating the book, chapter, and verse whence it was taken. The next summer, 1784, the same lady, or one of her sisters, kept school in the same district. The same books were in use, and there was the same routine of exercises. It was kept on the first floor of the steeple. The lower end of the bell-rope lay in a coil in the centre of the floor. The discipline was so strict, that no one, however mischievously disposed, I believe ever thought of taking hold of it, though it was something of an incumbrance. I was then four years and a half old, and had learned *by heart* nearly all the reading lessons in the Primer, and much of the Westminster Catechism, which was taught as the closing exercise every Saturday. But justice to one of the best of mothers requires that I should say that much the greater part of the improvement I had made was acquired from her careful instruction.

"In December, 1784, the month in which I was five years old, I attended, for a few days, the school kept by a master—I do not remember his name. When asked up for examination, he asked me if I could read without spelling? I said I could read in the Bible. He hesitated a moment, and then placed me on one of the benches, opened a Bible at the fifth chapter of Acts, and asked me to read. I read ten or a dozen verses—being the account of Ananias and his wife falling dead before Peter for telling a lie. Whether he had any suspicion that I had told a falsehood, and took this method to reprove me, I know not; but he dismissed me with approbation. He used his ferule on the hands of some of the elder boys; but the severest punishment that he inflicted for any violation of order, was compelling a boy who had brought into the school the breast-bone of a chicken, (commonly called the *wishing-bone*,) and with which he had excited some noise among the pupils, to stand on one of the benches and wear the bone on his nose till the school was dismissed. I am strongly impressed with the belief that Webster's spelling book made its first appearance in the schools during this winter. The following summer I attended, but very irregularly, a school kept as before in the steeple of the meeting-house,* and had a copy of Webster. Whether there were any other copies in the school or not I am not able to say. The next two winters, circumstances which I have no desire to recall, and which you would not care to be acquainted with, prevented my attending any school. In the summer of 1786, these same circumstances caused me to be removed to another district three miles distant from the central village. The farmer with whom I lived thought I could read well enough,.and as the district school-house was a mile or more distant, he considered it unnecessary to send me that distance in the winter, merely *to read;* and consequently for two or three winters I went to school not more than eight or ten days in each. At length, in 1790 or 1791, it was thought I was old enough to learn to *cipher*, and accordingly was permitted to go to school more constantly. I told the master I wanted to learn to cipher. He set me a *sum* in simple addition—*five columns* of figures, and *six figures* in each column. All the instruction he gave me was—add the figures in the first column, carry one for every ten, and set the overplus down under the column. I supposed he meant by the *first* column the left hand column; but what he meant by carrying one for every ten was as much a mystery as Samson's riddle was to the Philistines. I worried my brains an hour or two, and showed the master the figures I had made. You may judge what the amount was, when the columns were added from left to right. The master frowned and repeated his former instruction—add up the column *on the right*, carry one for every ten, and set down the remainder. Two or three afternoons (I did not go to school in the morning) were spent in this way, when I begged to be excused from learning to cipher, and the old gentleman with whom I lived thought it was time wasted; and if I attended the school any further at that time, reading and spelling, and a little writing were all that was taught. The next winter there was a teacher more communicative and better fitted for his place, and under him some progress was made in arithmetic, and I made a tolerable acquisition in the first four rules, according to Dilworth's Schoolmaster's Assistant, of which the teacher and one of the eldest boys had each a copy. The two following winters, 1794 and 1795, I mastered all the rules and examples in the first part of Dilworth; that is, through the various chapters of Rule of Three, Practice, Fellowship, Interest, etc. etc., to Geometrical Progression and Permutation.

"In our district, the books were of rather a miscellaneous character, such as had been in families perhaps half a century or more. My belief is that Webster's Spelling Book was not in general use before 1790 or 1791. The Bible was read by the first class in the morning, always, and generally in the afternoon before the closing exercise, which was always a lesson in spelling, and this was performed by all the pupils who were sufficiently advanced to pronounce distinctly words of more than one syllable. It was the custom for all such pupils to stand together as one class, and with *one voice* to read a column or two of the tables for spelling. The master gave the signal to begin, and all united to read, letter by letter, pronouncing each syllable by itself, and adding it to the preceding one till the word was complete. Thus, a-d *ad*, m-i *mi*, *admi*, r-a *ra*, *admira*, t-i-o-n *shun*, *admiration*. This mode of reading was exceedingly exciting, and, in my humble judgment, exceedingly useful; as it required and taught deliberate and distinct articulation, and inspired the youngest with a desire

* This was the last time I went to a *summer* school.

to equal the older ones. It is true the voices would not all be in perfect unison; but after a little practice they began to assimilate. I have heard a class of thirty or more read column after column in this manner, with scarcely a perceptible variation from the proper pitch of voice. When the lesson had been thus read, the books were closed, and the words given out for spelling. If one was misspelt, it passed on to the next, and the next pupil in order, and so on till it was spelt correctly. Then the pupil who had spelt correctly went up in the class *above* the one who had misspelt. It was also a practice, when one was absent from this exercise in spelling, that he should stand at the foot of the class when he returned. Another of our customs was to choose sides to spell once or twice a week. The words to be spelt went from side to side; and at the conclusion, the side which *beat* (spelt the most words) were permitted to leave the schoolroom, preceding the other side, who had to sweep the room and build the fires the next morning. These customs prevalent sixty and seventy years ago excited emulation, and emulation produced improvement. A revival of them, I have no doubt, would be advantageous in the common schools, especially where pupils are required to spell words given out indiscriminately from a reading book or dictionary. There was not, to my knowledge, any *reading book* proper, except the Bible, till Webster's Third Book, so called, came out about 1793 or 1794. A new edition of his spelling book furnished some new matter for reading—selections from the New Testament, a chapter of Proverbs, and a set of Tables, etc.; but none of these operated to the exclusion of the Bible.

"In the family in which I lived there were three or four old spelling books, which I presume had been used in schools before the period of my remembrance. One of these was a book of less than a hundred pages, printed in London, I think in 1690. The words were arranged in tables, according to syllables. The terminations tion, sion, cial, tial, etc., were all divided and printed as two distinct syllables. (And I believe this mode of printing is still continued in England. It was in the time of Lindley Murray, as may be seen in his spelling book, printed about forty years ago.) This spelling book contained a numeration table which, from a singular feature, early attracted my attention. Every figure was 9, and the whole formed a curious triangle. Thus:

9
99
999 and so on to
the last, 999,999,999

"Another spelling book in our farmer's library was by Daniel Fenning, printed in London. It contained a short treatise on grammar, on which I sometimes exercised my memory, but understood not one of its principles. We had also a Dilworth, containing certain fables—such as Jupiter and the Frogs, the Romish Priest and the Jester, Hercules and the Wagoner, etc., etc. Another still we had, the author of which I never knew, as several pages had been lost from the beginning. It had a page of proverbs, one of which—'a cat may look upon a king'—occasioned me much thoughtful exercise. It also had an appropriate collection of couplets for writing-copies, of which the only one I recollect was this:

"'X things a penman should have near at hand—
Paper, pounce, pen, ink, knife, hone, rule, plummet, wax, sand.'

But that which rendered the book so memorable as never to be forgotten, was the astonishing, if not terrific, word of fourteen syllables — 'Ho-no-ri-fi-ca-bi-li-tu-di-ni-tu-ti-bus-que'—asserted to be the longest word in the English language.

"In the winter of 1793–4, we had for a teacher Erastus Ripley, who was an under-graduate of Yale College. I mention his name, because I cannot look back upon the time when I had the advantage of his instruction without a feeling of reverence for the man and respect for the teacher. I learned more from him than all the schoolmasters I had been under. He took more pains to instruct us in reading than all his predecessors within my knowledge. He opened the school every morning with prayer—which had not been practised in our district. He was preparing for the ministry, and was afterwards settled at Canterbury, I think. He was highly esteemed by all the people of the district, and gave such an *impetus* to the ambition of the pupils, that a subscription was made to employ him an extra month after the usual term of the school had expired.

"Mr. Ripley was succeeded in the winter of 1794–5 by a young man from Lebanon by the name of Tisdale, under whom my school days were finished; and here I may bring this long and, I fear, very uninteresting letter to a close. Hoping this may serve the purpose for which you suggested the writing of it, and wishing you all the success you can desire in the noble cause in which you are engaged,

"I am, very respectfully
"And truly yours,
"Joseph T. Buckingham."

LETTER FROM REV. ELIPHALET NOTT, D.D., DATED JAN., 1861.

"When I was a boy, seventy-five or eighty years ago, in good old Puritan Connecticut, it was *felt* as a practical maxim 'that to spare the rod was to spoil the child;' and on this maxim the pedagogue acted in the school-room, and applied it for every offence, real or imaginary; and for having been whipped at school by the relentless master, the unfortunate tyro was often whipped at home by his no less relentless father; so that between the two relentless executors of justice among the Puritan fathers, few children, I believe, were spoiled by the withholding of this orthodox discipline. For myself, I can say (and I do not think I was wayward beyond the average of district school-boys) that, in addition to warnings, and admonitions daily, if I was not whipped more than three times a week, I considered myself for the time peculiarly fortunate.

"Being of a contemplative and forbearing disposition, this discipline of the rod became peculiarly irksome to me, and, as I thought, unjustifiable; and I formed a resolution, if I lived to be a man, I would not be like other men in regard to their treatment of children.

"Through the mercy of God I did live to be a man, and when at the age of eighteen I became installed as master of a district school in the eastern part of Franklin, Connecticut—a school where rebellious spirits had previously asserted their rights, and been subdued or driven from the school by the use of the rod—nothing daunted, I made up my mind to substitute in my school moral motives in the place of the rod; and I frankly told my assembled pupils so, and that if they would have the generosity to second my efforts, they would secure to themselves and furnish me and their parents the happiness which is the heaven-appointed reward of well-doing.

"The school responded to my appeal, and thereafter, though we played and gambolled together as equals in play-hours, and on Saturday afternoons, which were also devoted to play, the moment we entered the school-room, a subordination and application to study was observable, that became matter of remark and admiration among the inhabitants of the district, the fame of which success extended to other districts, and even to adjoining towns, so that the examination and exhibition with which the school closed the ensuing spring, called together clergymen and other officials from places quite remote.

"This success brought me to the knowledge of the trustees of the Plainfield Academy, one of the most important, if not at the time the most important academy in the state, and I was by a unanimous vote appointed principal of said academy—an institution in which several hundred children of both sexes were in the same building successfully taught and governed, for years, without the use of the rod, it being at that time the prevailing usage, both in district schools and academies, for the two sexes to be taught in the same room, and subjected to the same form of government.

"This successful experiment in the use of moral suasion, and other kindred and kindly influences, in place of the rod, led to other and kindred experiments, until, whether for the better or the worse, the rod at length came to occupy a very subordinate place in the system of school education.

"In those days, education in common schools was not so diffusive as at the present day; but quite as thorough, if not more so. The same remark may be applied to the higher schools or academies—the whole field of natural science being at that time, for the most part, unexplored; but mathematics and classics were zealously taught. In evidence of this, though inferior in attainments to some of my classmates, I published successfully myself an almanac when about twenty-one years of age.

"As the rod in those days was the principal instrument in common school education, so when I was afterward called to Union College, fines, suspensions, and expulsions were the principal instruments of collegiate government. The faculty sat in their robes as a court, caused offenders to be brought before them, examined witnesses, heard defences, and pronounced sentences with the solemnity of other courts of justice; and though Union College had on its catalogue but a very diminutive number of students, the sitting of the faculty as a court occupied no inconsiderable part of the time of its president and professors.

"Soon after I became connected with the college as its president, a case of discipline occurred which led to the trial and issued in the expulsion of a student belonging to a very respectable family in the city of Albany. According to the charter of Union College, the sentence of the faculty is not final. An appeal can be taken to the board of trustees, and in the case in question an appeal was taken, and, after keeping college in confusion for months, by the different hearings of the case, the board reversed the decision of the faculty, and restored the young man. On the event of this restoration, I informed them that they should never, during my administration, have occasion to review another case of discipline by the faculty; and during the fifty-six years which have since passed away, I have kept my word; and though we have been less successful in our system of parental government than could be wished, we have had no rebellions, and it is conceded, I believe generally, that quite as large a proportion of our young men have succeeded in after life as of any other collegiate institution in the Union."

RECOLLECTIONS OF PETER PARLEY.

The following picture of the District School as it was a few years later, in the town of Ridgefield,* one of the most advanced agricultural communities of Connecticut, is from the pen of Peter Parley, in his "*Recollections of a Lifetime.*"

"About three fourths of a mile from my father's house, on the winding road to Lower Salem, which bore the name of West Lane, was the school-house where I took my first lessons, and received the foundations of my very slender education. I have since been sometimes asked where I graduated: my reply has always been, 'At West Lane.' Generally speaking, this has ended the inquiry, whether because my interlocutors have confounded this venerable institution with 'Lane Seminary,' or have not thought it worth while to risk an exposure of their ignorance as to the college in which I was educated, I am unable to say.

"The site of the school-house was a triangular piece of land, measuring perhaps a rood in extent, and lying, according to the custom of those days, at the meeting of four roads. The ground hereabouts—as everywhere else in Ridgefield—was exceedingly stony, and in making the pathway the stones had been thrown out right and left, and there remained in heaps on either side, from generation to generation. All round was bleak and desolate. Loose, squat stone walls, with innumerable breaches, inclosed adjacent fields. A few tufts of elder, with here and there a patch of briers and pokeweed, flourished in the gravelly soil. Not a tree, however, remained, save an aged chestnut, at the western angle of the space. This certainly had not been spared for shade or ornament, but probably because it would have cost too much labor to cut it down, for it was of ample girth. At all events it was the oasis in our desert during summer; and in autumn, as the burrs disclosed its fruit, it resembled a besieged city. The boys, like so many catapults, hurled at it stones and sticks, until every nut had capitulated.

"Two houses only were at hand: one, surrounded by an ample barn, a teeming orchard, and an enormous wood-pile, belonged to Granther Baldwin; the other was the property of 'Old Chich-es-ter,' an uncouth, unsocial being, whom everybody for some reason or other seemed to despise and shun. His house was of stone and of one story. He had a cow, which every year had a calf. He had a wife—filthy, uncombed, and vaguely reported to have been brought from the old country. This is about the whole history of the man, so far as it is written in the authentic traditions of the parish. His

* "Nearly all the inhabitants of Ridgefield were farmers, with the few mechanics that were necessary to carry on society in a somewhat primeval state. Even the persons not professionally devoted to agriculture, had each his farm, or at least his garden and home lot, with his pigs, poultry, and cattle. The population might have been 1200, comprising 200 families. All could read and write, but in point of fact, beyond the Almanac and Watts' Psalms and Hymns, their literary acquirements had little scope. There were, I think, four newspapers, all weekly, published in the state: one at Hartford, one at New London, one at New Haven, and one at Litchfield. There were, however, not more than three subscribers to all these in our village. We had, however, a public library of some 200 volumes, and what was of equal consequence—the town was on the road which was then the great thoroughfare, connecting Boston with New York, and hence it had means of intelligence from travellers constantly passing through the place, which kept it up with the march of events."

premises, an acre in extent, consisted of a tongue of land between two of the converging roads. No boy, that I ever heard of, ventured to cast a stone or to make an incursion into this territory, though it lay close to the school-house. I have often, in passing, peeped timidly over the walls, and caught glimpses of a stout man with a drab coat, drab breeches, and drab gaiters, glazed with ancient grease and long abrasion, prowling about the house; but never did I discover him outside of his own dominion. I know it was darkly intimated that he had been a tory, and was tarred and feathered in the revolutionary war, but as to the rest he was a perfect myth. Granther Baldwin was a character no less marked, but I must reserve his picture for a subsequent letter.

"The school-house itself consisted of rough, unpainted clapboards, upon a wooden frame. It was plastered within, and contained two apartments—a little entry, taken out of a corner for a wardrobe, and the school-room proper. The chimney was of stone, and pointed with mortar, which, by the way, had been dug into a honeycomb by uneasy and enterprising penknives. The fireplace was six feet wide and four feet deep. The flue was so ample and so perpendicular, that the rain, sleet, and snow fell direct to the hearth. In winter, the battle for life with green fizzling fuel, which was brought in sled lengths and cut up by the scholars, was a stern one. Not unfrequently, the wood, gushing with sap as it was, chanced to be out, and as there was no living without fire, the thermometer being ten or twenty degrees below zero, the school was dismissed, whereat all the scholars rejoiced aloud, not having the fear of the schoolmaster before their eyes.

"It was the custom at this place to have a woman's school in the summer months, and this was attended only by young children. It was, in fact, what we now call a primary or infant school. In winter, a man was employed as teacher, and then the girls and boys of the neighborhood, up to the age of eighteen, or even twenty, were among the pupils. It was not uncommon, at this season, to have forty scholars crowded into this little building.

"I was about six years old when I first went to school. My teacher was Aunt Delight, that is, Delight Benedict, a maiden lady of fifty, short and bent, of sallow complexion and solemn aspect. I remember the first day with perfect distinctness. I went alone—for I was familiar with the road, it being that which passed by our old house. I carried a little basket, with bread and butter within, for my dinner, the same being covered over with a white cloth. When I had proceeded about half way, I lifted the cover, and debated whether I would not eat my dinner then. I believe it was a sense of duty only that prevented my doing so, for in those happy days I always had a keen appetite. Bread and butter were then infinitely superior to *paté de foie gras* now; but still, thanks to my training, I had also a conscience. As my mother had given me the food for dinner, I did not think it right to convert it into lunch, even though I was strongly tempted.

"I think we had seventeen scholars—boys and girls—mostly of my own age. Among them were some of my after companions. I have since met several of them—one at Savannah, and two at Mobile, respectably established, and with families around them. Some remain, and are now among the gray old men of the town; the names of others I have seen inscribed on the tombstones of their native village. And the rest—where are they?

"The school being organized, we were all seated upon benches, made of what were called *slabs*—that is, boards having the exterior or rounded part of the log on one side: as they were useless for other purposes, these were converted into school-benches, the rounded part down. They had each four supports, consisting of straddling wooden legs, set into auger holes. Our own legs swayed in the air, for they were too short to touch the floor. Oh, what an awe fell over me, when we were all seated and silence reigned around!

"The children were called up, one by one, to Aunt Delight, who sat on a low chair, and required each, as a preliminary, to make his manners, consisting of a small sudden nod or jerk of the head. She then placed the spelling-book—which was Dilworth's—before the pupil, and with a buck-handled penknife pointed, one by one, to the letters of the alphabet, saying, 'What's that?' If the child knew his letters the 'What's that?' very soon ran on thus:

"'What's that?'

"'A.'

"''Stha-a-t?'

"'B.'

"'Sna-a-a-t?'
"'C.'
"'Sna-a-a-t?'
"'D.'
"'Sna-a-a-t?'
"'E.' &c.

"I looked upon these operations with intense curiosity and no small respect, until my own turn came. I went up to the school-mistress with some emotion, and when she said, rather spitefully, as I thought, 'Make your obeisance!' my little intellects all fled away, and I did nothing. Having waited a second, gazing at me with indignation, she laid her hand on the top of my head, and gave it a jerk which made my teeth clash. I believe I bit my tongue a little; at all events, my sense of dignity was offended, and when she pointed to A, and asked what it was, it swam before me dim and hazy, and as big as a full moon. She repeated the question, but I was doggedly silent. Again, a third time, she said, 'What's that?' I replied: 'Why don't you tell me what it is? I didn't come here to learn you your letters!' I have not the slightest remembrance of this, for my brains were all a-wool-gathering; but as Aunt Delight affirmed it to be a fact, and it passed into tradition, I put it in. I may have told this story some years ago in one of my books, imputing it to a fictitious hero, yet this is its true origin, according to my recollection.

"What immediately followed I do not clearly remember, but one result is distinctly traced in my memory. In the evening of this eventful day, the school-mistress paid my parents a visit, and recounted to their astonished ears this, my awful contempt of authority. My father, after hearing the story, got up and went away; but my mother, who was a careful disciplinarian, told me not to do so again! I always had a suspicion that both of them smiled on one side of their faces, even while they seemed to sympathize with the old petticoat and penknife pedagogue, on the other; still I do not affirm it, for I am bound to say, of both my parents, that I never knew them, even in trifles, say one thing while they meant another.

"I believe I achieved the alphabet that summer, but my after progress, for a long time, I do not remember. Two years later I went to the winter-school at the same place, kept by Lewis Olmstead—a man who had a call for plowing, mowing, carting manure, etc., in summer, and for teaching school in the winter, with a talent for music at all seasons, wherefore he became chorister upon occasion, when, peradventure, Deacon Hawley could not officiate. He was a celebrity in ciphering, and 'Squire Seymour declared that he was the greatest 'arithmeticker' in Fairfield county. All I remember of his person is his hand, which seemed to me as big as Goliah's, judging by the claps of thunder it made in my ears on one or two occasions.

"The next step of my progress which is marked in my memory, is the spelling of words of two syllables. I did not go very regularly to school, but by the time I was ten years old I had learned to write, and had made a little progress in arithmetic. There was not a grammar, a geography, or a history of any kind in the school. Reading, writing, and arithmetic were the only things taught, and these very indifferently—not wholly from the stupidity of the teacher, but because he had forty scholars, and the standards of the age required no more than he performed. I did as well as the other scholars, certainly no better. I had excellent health and joyous spirits; in leaping, running, and wrestling, I had but one superior of my age, and that was Stephen Olmstead, a snug-built fellow, smaller than myself, and who, despite our rivalry, was my chosen friend and companion. I seemed to live for play: alas! how the world has changed since I have discovered that we live to agonize over study, work, care, ambition, disappointment, and then ——?

"As I shall not have occasion again, formally, to introduce this seminary into my narrative, I may as well close my account of it now. After I had left my native town for some twenty years, I returned and paid it a visit. Among the monuments that stood high in my memory was the West Lane school-house. Unconsciously carrying with me the measures of childhood, I had supposed it to be at least thirty feet square; how had it dwindled when I came to estimate it by the new standards I had formed! It was in all things the same, yet wholly changed to me. What I had deemed a respectable edifice, as it now stood before me was only a weather-beaten little shed, which, upon being measured, I found to be less than twenty feet square. It happened to be a warm, summer day, and I ventured to enter the place. I found a girl, some eighteen years old, keeping 'a ma'am school' for about twenty scholars, some of whom were studying Parley's Geography. The mistress was the daughter of one of my schoolmates, and some of the boys and girls were grandchildren of the little brood which gathered under the wing of Aunt Delight, when I was an a-b-c-darian. None of them, not even the school-mistress, had ever heard of me. The name of my father, as having ministered unto the people of Ridgefield in some bygone age, was faintly traced in their recollection. As to Peter Parley, whose Geography they were learning—they supposed him some decrepit old gentleman hobbling about on a crutch, a long way off, for whom, nevertheless, they had a certain affection, inasmuch as he had made geography into a story-book. The frontispiece-picture of the old fellow, with his gouty foot in a chair, threatening the boys that if they touched his tender toe, he would tell them no more stories, secured their respect, and placed him among the saints in the calendar of their young hearts. Well, thought I, if this goes on I may yet rival Mother Goose!

"At the age of ten years I was sent to the up-town school, the leading seminary of the village, for at this period it had not arrived at the honor of an academy, the institution being then, and many years after, under the charge of Master Stebbins. He was a man with a conciliating stoop in the shoulders, a long body, short legs, and a swaying walk. He was, at this period, some fifty years old, his hair being thin and silvery, and always falling in well-combed rolls over his coat-collar. His eye was blue, and his dress invariably of the same color. Breeches and knee-buckles, blue-mixed stockings, and shoes with bright buckles, seemed as much a part of the man as his head and shoulders. On the whole, his appearance was that of the middle-class gentleman of the olden time, and he was in fact what he seemed.

"This seminary of learning for the rising aristocracy of Ridgefield was a wooden edifice, thirty by twenty feet, covered with brown clapboards, and, except an entry, consisted of a single room. Around and against the walls ran a continuous line of seats, fronted by a continuous writing-desk. Beneath, were depositories for books and writing materials. The centre was occupied by slab seats, similar to those of West Lane. The larger scholars were ranged on the outer sides, at the desks; the smaller fry of a-b-c-darians were seated in the centre. The master was enshrined on the east side of the room, contrary, be it remembered, to the law of the French savans, which places dominion invariably in the west. Regular as the sun, Master Stebbins was in his seat at nine o'clock, and the performances of the school began.

"According to the Catechism—which, by the way, we learned and recited on Saturday—the chief end of man was to glorify God and keep his commandments: according to the routine of this school, one would have thought it to be reading, writing, and arithmetic, to which we may add spelling. From morning to night, in all weathers, through every season of the year, these exercises were carried on with the energy, patience, and perseverance of a manufactory.

"Master Stebbins respected his calling: his heart was in his work; and so, what he pretended to teach, he taught well. When I entered the school, I found that a huge stride had been achieved in the march of mind since I had left West Lane. Webster's Spelling Book had taken the place of Dilworth, which was a great improvement. The drill in spelling was very thorough, and applied every day to the whole school. I imagine that the exercises might have been amusing to a stranger, especially as one scholar would sometimes go off in a voice as grum as that of a bull-frog, while another would follow in tones as fine and piping as a peet-weet. The blunders, too, were often ineffably ludicrous; even we children would sometimes have tittered, had not such an enormity been certain to have brought out the birch. As to rewards and punishments, the system was this: whoever missed went down; so that perfection mounted to the top. Here was the beginning of the up and down of life.

"Reading was performed in classes, which generally plodded on without a hint from the master. Nevertheless, when Zeek Sanford—who was said to have a streak of lightning in him—in his haste to be smart, read the 37th verse of the 2d chapter of the Acts—'Now when they heard this, they were *pickled* in their heart'—the birch stick on Master Stebbins's table seemed to quiver and peel at the little end, as if to give warning of the wrath to come. When Orry Keeler—Orry was a girl, you know, and not a boy—drawled out in spelling: k—o—n, *kon*, s—h—u—n—t—s, *shunts*, konshunts—the bristles in the master's eyebrows fidgeted like Aunt Delight's knitting-needles. Occasionally, when the reading was insupportably bad, he took a book and read himself, as an example.

"We were taught arithmetic in Daboll, then a new book, and which, being adapted to our measures of length, weight, and currency, was a prodigious leap over the head of poor old Dilworth, whose rules and examples were modelled upon English customs. In consequence of the general use of Dilworth in our schools, for perhaps a century—pounds, shillings, and pence were classical, and dollars and cents vulgar, for several succeeding generations. 'I would not give a penny for it,' was genteel; 'I would not give a cent for it,' was plebeian. We have not yet got over this: we sometimes say *red cent* in familiar parlance, but it can hardly be put in print without offence.

"Master Stebbins was a great man with a slate and pencil, and I have an idea that we were a generation after his own heart. We certainly achieved wonders according to our own conceptions, some of us going even beyond the Rule of Three, and making forays into the mysterious region of Vulgar Fractions. Several daring geniuses actually entered and took possession.

"But after all, penmanship was Master Stebbins's great accomplishment. He had no magniloquent system; no pompous lessons upon single lines and bifid lines, and the like. The revelations of inspired copy-book makers had not then been vouchsafed to man. He could not cut an American eagle with a single flourish of a goose-quill. He was guided by good taste and native instinct, and wrote a smooth round hand, like copper-plate. His lessons from A to &, all written by himself, consisted of pithy proverbs and useful moral lessons. On every page of our writing-books he wrote the first line himself. The effect was what might have been expected—with such models, patiently enforced, nearly all became good writers.

"Beyond these simple elements, the Uptown school made few pretensions. When I was there, two Webster's Grammars and one or two Dwight's Geographies were in use. The latter was without maps or illustrations, and was in fact little more than an expanded table of contents, taken from Morse's Universal Geography—the mammoth monument of American learning and genius of that age and generation. The grammar was a clever book; but I have an idea that neither Master Stebbins nor his pupils ever fathomed its depths. They floundered about in it, as if in a quagmire, and after some time came out pretty nearly where they went in, though perhaps a little obfuscated by the dim and dusky atmosphere of these labyrinths.

"The fact undoubtedly is, that the art of teaching, as now understood, beyond the simplest elements, was neither known nor deemed necessary in our country schools in their day of small things. Repetition, drilling, line upon line, and precept upon precept, with here and there a little of the birch—constituted the entire system.

"Let me here repeat an anecdote, which I have indeed told before, but which I had from the lips of its hero, G . . . H . . ., a clergyman of some note thirty years ago, and which well illustrates this part of my story. At a village school, not many miles from Ridgefield, he was put into Webster's Grammar. Here he read, '*A noun is the name of a thing—as horse, hair, justice.*' Now in his innocence, he read it thus: '*A noun is the name of a thing—as horse-hair justice.*'

"'What then,' said he, ruminating deeply, 'is a noun? But first I must find out what a horse-hair justice is.'

"Upon this he meditated for some days, but still he was as far as ever from the solution. Now his father was a man of authority in those parts, and moreover he was a justice of the peace. Withal, he was of respectable ancestry, and so there had descended to him a somewhat stately high-backed settee, covered with horse-hair. One day, as the youth came from school, pondering upon the great grammatical problem, he entered the front door of the house, and there he saw before him, his father, officiating in his legal capacity, and seated upon the old horse-hair settee. 'I have found it!' said the boy to himself, as greatly delighted as was Archimedes when he exclaimed *Eureka*—'my father is a horse-hair justice, and therefore a noun!'

"Nevertheless, it must be admitted that the world got on remarkably well in spite of this narrowness of the country schools. The elements of an English education were pretty well taught throughout the village seminaries of Connecticut, and I may add, of New England. The teachers were heartily devoted to their profession: they respected their calling, and were respected and encouraged by the community. They had this merit, that while they attempted but little, that, at least, was thoroughly performed.

"As to the country at large, it was a day of quiet, though earnest action: Franklin's spirit was the great 'schoolmaster abroad'—teaching industry, perseverance, frugality, and thrift, as the end and aim of ambition. The education of youth was suited to what was expected of them. With the simple lessons of the country schools, they moved the world immediately around them. Though I can recollect only a single case—that already alluded to of Ezekiel Sanford—in which one of Master Stebbins's scholars attained any degree of literary distinction, still, quite a number of them, with no school learning beyond what he gave them, rose to a certain degree of eminence. His three sons obtained situations in New York as accountants, and became distinguished in their career. At one period there were three graduates of his school, who were cashiers of banks in that city. My mind adverts now with great satisfaction to several names among the wealthy, honorable, and still active merchants of the great metropolis, who were my fellow-students of the Up-town school, and who there began and completed their education."

To the advantages, such as they were, of the district school, Mr. Goodrich adds an account of his experience on the farm, and his juvenile sports, as well as his early attempts at *whittling* and other mechanical arts, and adds the following reflections:—

"Now all these things may seem trifles, yet in a review of my life, I deem them of some significance. This homely familiarity with the more mechanical arts was a material part of my education; this communion with nature gave me instructive and important lessons from nature's open book of knowledge. My technical education, as will be seen hereafter, was extremely narrow and irregular. This defect was at last partially supplied by the commonplace incidents I have mentioned. The teaching, or rather the training of the senses, in the country—ear and eye, foot and hand, by running, leaping, climbing over hill and mountain, by occasional labor in the garden and on the farm, and by the use of tools—and all this in youth, is sowing seed which is repaid largely and readily to the hand of after cultivation, however unskilful it may be. This is not so much because of the amount of knowledge available in after-life, which is thus obtained—though this is not to be despised—as it is that healthful, vigorous, manly habits and associations—physical, moral, and intellectual—are thus established and developed.

"It is a riddle to many people that the emigrants from the country into the city, in all ages, outstrip the natives, and become their masters. The reason is obvious: country education and country life are practical, and invigorating to body and mind, and hence those who are thus qualified triumph in the race of life. It has always been, it will always be so; the rustic Goths and Vandals will march in and conquer Rome, in the future, as they have done in the past. I say this, by no means insisting that my own life furnishes any very striking proof of the truth of my remarks; still, I may say that but for the country training and experience I have alluded to, and which served as a foothold for subsequent progress, I should have lingered in my career far behind the humble advances I have actually made.

"Let me illustrate and verify my meaning by specific examples. In my youth I became familiar with every bird common to the country: I knew his call, his song, his hue, his food, his habits; in short, his natural history. I could detect him by his flight, as far as the eye could reach. I knew all the quadrupeds—wild as well as tame. I was acquainted with almost every tree, shrub, bush, and flower, indigenous to the country; not botanically, but according to popular ideas. I recognized them instantly, wherever I saw them; I knew their forms, hues, leaves, blossoms, and fruit. I could tell their characteristics, their uses, the legends and traditions that belonged to them. All this I learned by familiarity with these objects; meeting with them in all my walks and rambles, and taking note of them with the emphasis and vigor of early experience and observation. In after days, I have never had time to make natural history a systematic study; yet my knowledge as to these things has constantly accumulated, and that without special effort. When I have travelled in other countries, the birds, the animals, the vegetation, have interested me as well by their resemblances as their differences, when compared with our own.

In looking over the pages of scientific works on natural history, I have always read with eagerness and intelligence of preparation; indeed, of vivid and pleasing associations. Every idea I had touching these matters was living and sympathetic, and beckoned other ideas to it, and these again originated still others. Thus it is that in the race of a busy life, by means of a homely, hearty start at the beginning, I have, as to these subjects, easily and naturally supplied, in some humble degree, the defects of my irregular education, and that too, not by a process of repulsive toil, but with a relish superior to all the seductions of romance. I am therefore a believer in the benefits accruing from simple country life and simple country habits, as here illustrated, and am, therefore, on all occasions anxious to recommend them to my friends and countrymen. To city people, I would say, educate your children, at least partially, in the country, so as to imbue them with the love of nature, and that knowledge and training which spring from simple rustic sports, exercises, and employments. To country people, I would remark, be not envious of the city, for in the general balance of good and evil, you have your full portion of the first, with a diminished share of the last."

### THE HOMESPUN ERA OF COMMON SCHOOLS. BY HORACE BUSHNELL, D.D.

"But the schools—we must not pass by these, if we are to form a truthful and sufficient picture of the homespun days. The schoolmaster did not exactly go round the district to fit out the children's minds with learning, as the shoemaker often did to fit their feet with shoes, or the tailor to measure and cut for their bodies; but, to come as near it as possible, he boarded round, (a custom not yet gone by,) and the wood for the common fire was supplied in a way equally primitive, viz., by a contribution of loads from the several families, according to their several quantities of childhood. The children were all clothed alike in homespun; and the only signs of aristocracy were, that some were clean and some a degree less so, some in fine white and striped linen, some in brown tow crash; and, in particular, as I remember, with a certain feeling of quality I do not like to express, the good fathers of some testified the opinion they had of their children, by bringing fine round loads of hickory wood to warm them, while some others, I regret to say,



brought only scanty, scraggy, ill-looking heaps of green oak, white birch, and hemlock. Indeed, about all the bickerings of quality among the children, centered in the quality of the wood pile. There was no complaint, in those days, of the want of ventilation; for the large open fire-place held a considerable fraction of a cord of wood, and the windows took in just enough air to supply the combustion. Besides, the bigger lads were occasionally ventilated, by being sent out to cut wood enough to keep the fire in action. The seats were made of the outer slabs from the saw-mill, supported by slant legs driven into and a proper distance through auger holes, and planed smooth on the top by the rather tardy process of friction. But the spelling went on bravely, and we ciphered away again and again, always till we got through Loss and Gain. The more advanced of us, too, made light work of Lindley Murray, and went on to the parsing, finally, of extracts from Shakspeare and Milton, till some of us began to think we had mastered their tough sentences in a more consequential sense of the term than was exactly true. O, I remember (about the remotest thing I can remember) that low seat, too high, nevertheless, to allow the feet to touch the floor, and that friendly teacher who had the address to start a first feeling of enthusiasm and awaken the first sense of power. He is living still, and whenever I think of him, he rises up to me in the far background of memory, as bright as if he had worn the seven stars in his hair. (I said he is living; yes, he is here to-day, God bless him!) How many others of you that are here assembled, recall these little primitive universities of homespun, where your mind was born, with a similar feeling of reverence and homely satisfaction. Perhaps you remember, too, with a pleasure not less genuine, that you received the classic discipline of the university proper, under a dress of homespun, to be graduated, at the close, in the joint honors of broadcloth and the parchment."

We might add other lights and shades to the picture of school life as it was down to a very recent period in New England and New York, but we must refer our readers to that amusing and instructive volume of Rev. Warren Burton, "The District School as it was." We must pass to the elementary schools of Pennsylvania and the Southern States.

LETTER FROM WILLIAM DARLINGTON, M.D., LL.D.

"At your request, I propose to attempt a brief and hasty sketch of my acquaintance with, and reminiscences of the *Country Schools*, and their condition, some sixty-five or seventy years since, in the south-eastern corner of the state of Pennsylvania; more particularly the school at Birmingham, Chester county, where the limited instruction of my youthful days was chiefly acquired.

"My earliest recollections of the school to which I was sent go back to that trying period of loose government, rusticity, and scarcity experienced in the interval between the War of Independence and the adoption of the Federal Constitution; and if it were given me to wield the pen of *Tom Brown of Rugby*, I might peradventure furnish some graphic details of our rural seminaries of learning in those days of general destitution. But, under present circumstances, I can only offer the imperfect narrative of incidents and observations, as retained in an almost octogenarian memory.

"At the time when I was first sent to school—say in 1787–8—school-houses were rare; and there was little or no organization for their maintenance. The country round, having been recently ravaged by a hostile army, was scantily supplied with teachers, who occasionally obtained schools by going among the principal families of the vicinage, and procuring subscribers for a quarter's tuition of the children on hand. Those who were too young to be serviceable on the farm were allowed to go to school in the summer season; but the larger ones (*expertus loquor*) could only be spared for that purpose during winter. The extent of rural instruction was then considered to be properly limited to what a worthy London alderman designated as the *three R's*, viz., 'Reading, Riting, and Rithmetic.' To cipher beyond the *Rule of Three* was deemed a notable achievement and mere surplusage among the average of country scholars. The business of teaching, at that day, was disdainfully regarded as among the humblest and most unprofitable of callings; and the *teachers*—often low-bred, intemperate adventurers from the old world—were generally about on a *par* with the prevalent estimate of the profession. Whenever a thriftless vagabond was found to be good for nothing else, he would resort to *school-keeping*, and teaching young American ideas how to shoot! It was my good fortune, however, to have a teacher who was a distinguished exception to the sorry rule referred to. JOHN FORSYTHE was a native of the Emerald Isle, born in 1754, received a good English education at home, and while yet a young man, migrated to the county of *Chester*, in the land of PENN, where he became an excellent schoolmaster. When he arrived in our quakerly settlement, he was a gay young Presbyterian, dressed in the fashionable apparel of the world's people; and being withal musical in his taste, was an expert performer on the violin. He soon, however, adopted the views and principles of the 'Friends,' among whom he remained, married one of the society, and was ever recognized as an exemplary and valuable member.

"As the head and master-spirit of the school, at Birmingham meeting-house, established under the auspices of the Quaker society, he taught for a number of years, and always applied himself *con amore* to his arduous duties. He accomplished more in exciting a taste for knowledge and developing young intellects, than any teacher who had theretofore labored in that hopeful vineyard. He effectually routed the lingering old superstitions, prejudices, and benighted notions of preceding generations, and ever took delight in introducing youthful genius to the bright fields of literature and science. The young men of his day, who have since figured in the world, were deeply indebted to John Forsythe for the aid which he afforded them in their studies, as well as for the sound doctrines which he inculcated; and some few of them yet survive to make the grateful acknowledgment.

"When the noble Quaker institution at *West-town* was erected, near the close of the last century, the skill and experience of John Forsythe were put in requisition, until it was fairly inaugurated; after which he retired to his comfortable farm, in East Bradford, where he passed a venerable old age, until his 87th year, in superintending agricultural employments and in manifesting a lively interest in the progress of education among our people. No instructor has labored in this community more faithfully, nor with better effect. None has left a memory more worthy to be kindly cherished.

"The old *school-house* at Birmingham was a one story stone building, erected by men who did not understand the subject; and was badly lighted and ventilated. The *discipline* of that day (adopted from the mother country) was pretty severe. The real *birch* of the botanists not being indigenous in the immediate vicinity of the school, an efficient substitute was found in young apple tree sprouts, as unruly boys were abundantly able to testify.

"The *school books* of my earliest recollection were a cheap English spelling book, the Bible for the reading classes, and when we got to ciphering, the 'Schoolmasters' Assistant.' The 'Spelling Book' and 'Assistant' were by Thomas Dilworth, an English schoolmaster at Wapping. The 'Assistant' was a useful work, but has long since disappeared. The 'counterfeit presentment' of the worthy author faced the title-page, and was familiarly known to every schoolboy of my time. The Spelling Book contained a little elementary grammar, in which the English substantives were declined through all the cases (genitive, dative, etc.) of the Latin. But *grammar* was then an unknown study among us. Dilworth's 'Spelling Book,' however, was soon superseded by a greatly improved one, compiled by John Pierce, a respectable teacher of Delaware county, Pennsylvania. This comprised a tolerable English grammar, for that period, and John Forsythe introduced the study into his school with much zeal and earnestness. Intelligent employers were made to comprehend its advantages, and were pleased with the prospect of a hopeful advance in that direction; but dull boys and illiterate parents could not appreciate the benefit. Great boobies often got permission, at home, to evade the study, but they could not get round John Forsythe in that way. They would come into school with this promised indulgence, and loudly announce, 'Daddy says I needn't *larn grammar;* it's no use:' when the energetic response from the desk was, 'I don't care what daddy says. He knows nothing about it; and I say thou shalt learn it!' and so some general notion of the subject was impressed upon the minds even of the stupid; while many of the brighter youths became excellent grammarians.

"In this *Friendly* seminary we were all required to use the *plain language* in conversation, being assured that it was wrong, both morally and grammatically, to say *you* to one person. Our teacher contrived a method of his own for mending our cacology, even while at our noonday sports. He prepared a small piece of board or shingle, which he termed a *paddle;* and whenever a boy was heard uttering bad grammar, he had to take the paddle, step aside, and refrain from play, until he detected some other unlucky urchin trespassing upon syntax; when he was authorized to transfer the badge of interdiction to the last offender, and resume his amusements. It was really curious to observe how critical we soon became, and how much improvement was effected by this whimsical and simple device.

"Pierce's 'Spelling Book' kept its position in our school for several years, but was at length superseded, in the grammatical department, by a useful little volume, prepared by *John Comly*, of Bucks county, Pennsylvania. *Lindley Murray* and others prepared elaborate grammars, which were successively introduced, as our schools improved or created a demand; and so rapidly have the bookmaking competitors in that department multiplied that their name is now legion, and the respective value of their works is known only to experts in the art of teaching.

"Excellent works in *Reading* and *Elocution* are now so abundant and well known in all our respectable seminaries, that they need not to be here enumerated. One of the best and most popular of those works, some half century or more since, was a volume entitled 'The Art of Speaking,' compiled, I think, by a Mr. Rice, in England.

"But, as we have now reached the age of academies, normal institutes, and schools for the people, I presume you will gladly forego a further extension of this prosy narrative, so little calculated to interest a veteran in the great cause of education. I have ever been a sincere friend and advocate of the blessing; but, unfortunately, my acquaintance with it has been mainly limited to a humbling consciousness of my deficiencies in the ennobling attainment.

"Very respectfully,

"Wm. Darlington.

"West Chester, Pa., Dec. 21, 1860."

### SCHOOLS IN PHILADELPHIA.

The following picture of the internal economy of one of the best schools of Philadelphia, is taken from Watson's "Annals of Philadelphia and Pennsylvania."

"My facetious friend, Lang Syne, has presented a lively picture of the 'schoolmasters' in those days, when 'preceptors,' and 'principals,' and 'professors' were yet unnamed. What is now known as 'Friends' Academy,' in Fourth street, was at that time occupied by four different masters. The best room down-stairs by Robert Proud, Latin master; the one above him, by William Waring, teacher of astronomy and mathematics; the east room, up-stairs, by Jeremiah Paul, and the one below, 'last not least' in our remembrance, by J. Todd, and severe he was. The State House clock, being at the time visible from the school pavement, gave to the eye full notice when to break off marble and plug top, hastily collect the 'stakes,' and bundle in, pell-mell, to the school-room, where, until the arrival of the 'master of scholars,' John Todd, they were busily employed, every one in finding his place, under the control for the time of a short Irishman, usher, named Jimmy M'Cue. On the entrance of the master, all shuffling of the feet, 'scrouging,' hitting of elbows, and whispering disputes, were hastily adjusted, leaving a silence which might be felt, 'not a mouse stirring.' He, Todd, dressed after the plainest manner of Friends, but of the richest material, with looped cocked hat, was at all times remarkably clean and nice in his person, a man of about sixty years, square built, and well sustained by bone and muscle.

"After an hour, maybe, of quiet time, every thing going smoothly on—no sound, but from the master's voice, while hearing the one standing near him, a dead calm, when suddenly a brisk slap on the ear or face, for something or for nothing, gave 'dreadful note' that an eruption of the lava was now about to take place. Next thing to be seen was 'strap in full play over the head and shoulders of Pilgarlic.' The passion of the master 'growing by what it fed on,' and wanting elbow room, the chair would be quickly thrust on one side, when, with sudden gripe, he was to be seen dragging his struggling suppliant to the flogging ground, in the centre of the room; having placed his left foot upon the end of a bench, he then, with a patent jerk, peculiar to himself, would have the boy completely horsed across his knee, with his left elbow on the back of his neck, to keep him securely on. In the hurry of the moment he would bring his long pen with him, griped between his strong teeth (visible the while), causing both ends to descend to a parallel with his chin, and adding much to the terror of the scene. His face would assume a deep claret color—his little bob of hair would disengage itself, and stand out, each 'particular hair' as it were, 'up in arms and eager for the fray.' Having his victim thus completely at command, and all useless drapery drawn up to a bunch above the waistband, and the rotundity and the nankeen in the closest affinity possible for them to be, then once more to the 'staring crew' would be exhibited the dexterity of master and strap. By long practice he had arrived at such perfection in the exercise, that, moving in quick time, the fifteen inches of bridle rein (*alias* strap) would be seen after every cut, elevated to a perpendicular above his head; from whence it descended like a flail on the stretched nankeen, leaving 'on the place beneath' a fiery red streak, at every slash. It was customary with him to address the sufferer at intervals, as follows: 'Does it hurt?' 'Oh! yes, master; oh! don't, master.' 'Then I'll make it hurt thee more. I'll make thy flesh creep—thou shan't want a warming pan tonight. Intolerable being! Nothing in nature is able to prevail upon thee but my strap.' He had one boy named George Fudge, who usually wore leather breeches, with which he put strap and its master at defiance. He would never acknowledge pain—he would not 'sing out.' Todd seized him one day, and having gone through the evolutions of strapping (as useless, in effect, as if he had been thrashing a flour-bag), almost breathless with rage, he once more appealed to the feelings of the 'reprobate,' by saying: 'Does it not hurt?' The astonishment of the school and the master was completed, on hearing him sing out, 'No! Hurray for leather crackers!' He was thrown off immediately, sprawling on the floor, with the benediction as follows: 'Intolerable being! Get out of my school. Nothing in nature is able to prevail upon thee—not even my strap!'

"'Twas not 'his love of learning was in fault,' so much as the old British system of introducing learning and discipline into the brains of boys and soldiers by dint of punishment. The system of flogging on all occasions in schools, for something or for nothing, being protected by law, gives free play to the passions of the master, which he, for one, exercised with great severity.

The writer has, at this moment, in his memory, a schoolmaster *then* of this city, who, a few years ago, went deliberately out of his school to purchase a cow-skin, with which, on his return, he extinguished his bitter revenge on a boy who had offended him. The age of chivalry preferred ignorance in its sons, to having them subjected to the fear of a pedagogue—believing that a boy who had quailed under the eye of the schoolmaster, would never face the enemy with boldness on the field of battle; which it must be allowed is 'a swing of the pendulum' too far the other way. A good writer says: 'We do not *harden* the wax to receive the impression—wherefore, the teacher seems himself most in need of *correction*—for he, unfit to teach, is making them unfit to be taught!'

"I have been told by an aged gentleman, that in the days of his boyhood, sixty-five years ago, when boys and girls were together, it was a common practice to make the boys strip off their jackets, and loose their trowsers' band, preparatory to hoisting them upon a boy's back so as to get his whipping, with only the linen between the flesh and the strap. The girls too—we pity them—were obliged to take off their stays to receive their floggings with equal sensibility. He named one distinguished lady, *since*, who was so treated among others, in his school. All the teachers then were from England and Ireland, and brought with them the rigorous principles which had before been whipped into themselves at home."

Robert Coram, in a pamphlet devoted in part to a "Plan for the General Establishment of Schools throughout the United States," printed in Wilmington, Delaware, in 1791, characterizes the state of education as follows: "The country schools, through most of the United States, whether we consider the buildings, the teachers, or the regulations, are in every respect completely despicable, wretched, and contemptible. The buildings are in general sorry hovels, neither wind-tight nor water-tight; a few stools serving in the double capacity of bench and desk, and the old leaves of copy books making a miserable substitute for glass windows. The teachers are generally foreigners, shamefully deficient in every qualification necessary to convey instruction to youth, and not seldom addicted to gross vices. Absolute in his own opinion, and proud of introducing what he calls his European method, one calls the first letter of the alphabet, *aw*. The school is modified upon this plan, and the children who are advanced are beat and cuffed to forget the former mode they have been taught, which irritates their minds and retards their progress. The quarter being finished, the children lie idle until another master offers, few remaining in one place more than a quarter. When the next schoolmaster is introduced, he calls the first letter *a*, as in mat; the school undergoes another reform, and is equally vexed and retarded. At his removal a third is introduced, who calls the first letter *hay*. All these blockheads are equally absolute in their own notions, and will by no means suffer the children to pronounce the letter as they were first taught; but every three months the school goes through a reform—error succeeds error, and dunce the second reigns like dunce the first. I will venture to pronounce, that however seaport towns, from local circumstances, may have good schools, the country schools will remain in their present state of despicable wretchedness, unless incorporated with government. * * * The necessity of a reformation in the country schools is too obvious to be insisted on; and the first step to such a reformation will be by turning private schools into public ones. The schools should be public, for several reasons—1st. Because, as has been before said, every citizen has an equal right to subsistence, and ought to have an equal opportunity of acquiring knowledge. 2d. Because public schools are easiest maintained, as the burthen falls upon all the citizens. The man who is too squeamish or lazy to get married, contributes to the support of public schools, as well as the man who is burthened with a large family. But private schools are supported only by heads of families, and by those only while they are interested; for as soon as the children are grown up, their support is withdrawn; which makes the employment so precarious, that men of ability and merit will not submit to the trifling salaries allowed in most country schools, and which, by their partial support, cannot afford a better."

### SCHOOL HOLIDAY IN GEORGIA.

We have not been very successful in gathering the printed testimony of the dead, or the vivid reminiscences of the living, respecting the internal economy of schools, public or family, in any of the Southern states prior to 1800. The following graphic sketch of "the turn out" of the schoolmaster, from Judge Longstreet's "Georgia Scenes," is said to be "literally true:"

"In the good old days of *fescues*, *abisselfas* and *anpersants*,* terms which used to be familiar in this country during the Revolutionary war, and which lingered in some of our country schools for a few years afterward, I visited my friend Captain Griffen, who resided about seven miles to the eastward of Wrightsborough, then in Richmond, but now in Columbia county. I reached the captain's hospitable home on Easter, and was received by him and his good lady with a *Georgia welcome* of 1790.

"The day was consumed in the interchange of news between the captain and myself (though, I confess, it might have been better employed), and the night found us seated round a temporary fire, which the captain's sons had kindled up for the purpose of dyeing eggs. It was a common custom of those days with boys to dye and peck eggs on Easter Sunday, and for a few days afterward. They were colored according to the fancy of the dyer; some yellow, some green, some purple, and some with a variety of colors, borrowed from a piece of calico. They were not unfrequently beautified with a taste and skill which would have extorted a compliment from Hezekiah Niles, if he had seen them a year ago, in the hands of the '*young operatives*,' in some of the northern manufactories. No sooner was the work of dyeing finished, than our 'young operatives' sallied forth to stake the whole proceeds of their '*domestic industry*' upon a peck. Egg was struck against egg, point to point, and the egg that was broken was given up as lost to the owner of the one which came whole from the shock.

"While the boys were busily employed in the manner just mentioned, the captain's youngest son, George, gave us an anecdote highly descriptive of the Yankee and Georgia character, even in their buddings, and at this early date. 'What you think, pa,' said he, 'Zeph Pettibone went and got his uncle Zach to turn him a wooden egg; and he won a whole hatful o' eggs from all us boys 'fore we found it out; but, when we found it out, maybe John Brown didn't smoke him for it, and took away all his eggs, and give 'em back to us boys; and you think he didn't go then and git a guinea egg, and win most as many more, and John Brown would o' give it to him agin if all we boys hadn't said we thought it was fair. I never see such a boy as that Zeph Pettibone in all my life. He don't mind whipping no more 'an nothing at all, if he can win eggs.'

"This anecdote, however, only fell in by accident, for there was an all-absorbing subject which occupied the minds of the boys during the whole evening, of which I could occasionally catch distant hints, in under tones and whispers, but of which I could make nothing, until they were afterward explained by the captain himself. Such as 'I'll be bound Pete Jones and Bill Smith stretches him.' 'By Jockey, soon as they seize him, you'll see me down upon him like a duck upon a June-bug.' 'By the time he touches the ground, he'll think he's got into a hornet's nest,' etc.

"'The boys,' said the captain, as they retired, 'are going to turn out the schoolmaster to-morrow, and you can perceive they think of nothing else. We must go over to the schoolhouse and witness the contest, in order to prevent injury to preceptor or pupils; for, though the master is always, upon such occasions, glad to be turned out, and only struggles long enough to present his patrons a fair apology for giving the children a holiday, which he desires as much as they do, the boys always conceive a holiday gained by a 'turn out' as the sole achievement of their valor; and in their zeal to distinguish themselves upon such memorable occasions, they sometimes become too rough, provoke the master to wrath, and a very serious conflict ensues. To prevent these consequences, to bear witness that the master was *forced* to yield before he would withhold a day of his promised labor from his

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* The *fescue* was a sharpened wire or other instrument used by the preceptor to point out the letters to the children.

*Abisselfa* is a contraction of the words "a by itself, a." It was usual, when either of the vowels constituted a syllable of a word, to pronounce it, and denote its independent character by the words just mentioned, thus: "a by itself, *a*, c-o-r-n corn, *acorn*;" "e by itself, *e*, v-i-l, *evil*," etc.

The character which stands for the word "*and*" (&) was probably pronounced with the same accompaniment, but in terms borrowed from the Latin language, thus: "& *per se*" (by itself) *and*. Hence, "anpersant."

employers, and to act as a mediator between him and the boys in settling the articles of peace, I always attend; and you must accompany me to-morrow.' I cheerfully promised to do so.

"The captain and I rose before the sun, but the boys had risen and were off to the school-house before the dawn. After an early breakfast, hurried by Mrs. G. for our accommodation, my host and myself took up our line of march toward the school-house. We reached it about half an hour before the master arrived, but not before the boys had completed its fortifications. It was a simple log pen, about twenty feet square, with a doorway cut out of the logs, to which was fitted a rude door, made of clapboards, and swung on wooden hinges. The roof was covered with clapboards also, and retained in their places by heavy logs placed on them. The chimney was built of logs, diminishing in size from the ground to the top, and overspread inside and out with red clay mortar. The classic hut occupied a lovely spot, overshadowed by majestic hickories, towering poplars, and strong-armed oaks. The little plain on which it stood was terminated, at the distance of about fifty paces from its door, by the brow of a hill, which descended rather abruptly to a noble spring that gushed joyously forth among the roots of a stately beech at its foot.

"The boys had strongly fortified the school-house, of which they had taken possession. The door was barricaded with logs, which I should have supposed would have defied the combined powers of the whole school. The chimney, too, was nearly filled with logs of goodly size; and these were the only passways to the interior. I concluded, if a *turn out* was all that was necessary to decide the contest in favor of the boys, they had already gained the victory. They had, however, not as much confidence in their outworks as I had, and therefore had armed themselves with long sticks, not for the purpose of using them upon the master if the battle should come to close quarters, for this was considered unlawful warfare, but for the purpose of guarding their *works* from his approaches, which it was considered perfectly lawful to protect by all manner of jabs and punches through the cracks. From the early assembling of the girls, it was very obvious that they had been let into the conspiracy, though they took no part in the active operations. They would, however, occasionally drop a word of encouragement to the boys, such as 'I wouldn't turn out the master; but if I did turn him out, I'd die before I'd give up.'

"At length Mr. Michael St. John, the schoolmaster made his appearance. Though some of the girls had met him a quarter of a mile from the school-house, and told him all that had happened, he gave signs of sudden astonishment and indignation when he advanced to the door, and was assailed by a whole platoon of sticks from the cracks: 'Why, what does all this mean?' said he, as he approached the captain and myself, with a countenance of two or three varying expressions.

"'Why,' said the captain, 'the boys have turned you out, because you have refused to give them an Easter holiday.'

"'Oh,' returned Michael, 'that's it, is it? Well, I'll see whether their parents are to pay me for letting their children play when they please.' So saying, he advanced to the school-house, and demanded, in a lofty tone, of its inmates, an unconditional surrender.

"'Well, give us a holiday, then,' said twenty little urchins within, 'and we'll let you in.'

"'Open the door of the *academy*'—(Michael would allow nobody to call it a school-house)—'Open the door of the academy this instant,' said Michael, 'or I'll break it down.'

"'Break it down,' said Pete Jones and Bill Smith, 'and we'll break you down.'

"During this colloquy I took a peep into the fortress, to see how the garrison were affected by the parley. The little ones were obviously panic-struck at the first words of command; but their fears were all chased away by the bold determined reply of Pete Jones and Bill Smith, and they raised a whoop of defiance.

"Michael now walked round the academy three times, examining all its weak points with great care. He then paused, reflected for a moment, and wheeled off suddenly toward the woods, as though a bright thought had just struck him. He passed twenty things which I supposed he might be in quest of, such as huge stones, fence rails, portable logs, and the like, without bestowing the least attention upon them. He went to one old log, searched it thoroughly, then to another, then to a hollow stump, peeped into it with great care, then to a hollow log, into which he looked with equal caution, and so on.

"'What is he after?' inquired I.

"'I'm sure I don't know,' said the captain, 'but the boys do. Don't you notice the breathless silence which prevails in the school-house, and the intense anxiety with which they are eyeing him through the cracks?'

"At this moment Michael had reached a little excavation at the root of a dogwood, and was in the act of putting his hand into it, when a voice from the garrison exclaimed, with most touching pathos, 'Lo'd o' messy, he's found my eggs! boys, let's give up.'

"'I won't give up,' was the reply from many voices at once.

"'Rot your cowardly skin, Zeph Pettibone, you wouldn't give a wooden egg for all the holydays in the world.'

"If these replies did not reconcile Zephaniah to his apprehended loss, it at least silenced his complaints. In the mean time Michael was employed in relieving Zeph's storehouse of its provisions; and, truly, its contents told well for Zeph's skill in egg-pecking. However, Michael took out the eggs with great care, and brought them within a few paces of the schoolhouse, and laid them down with equal care in full view of the besieged. He revisited the places which he had searched, and to which he seemed to have been led by intuition; for from nearly all of them did he draw eggs, in greater or less numbers. These he treated as he had done Zeph's, keeping each pile separate. Having arranged the eggs in double files before the door, he marched between them with an air of triumph, and once more demanded a surrender, under pain of an entire destruction of the garrison's provisions.

"'Break 'em just as quick as you please,' said George Griffin; 'our mothers 'll give us a plenty more, won't they, pa?'

"'I can answer for yours, my son,' said the captain; 'she would rather give up every egg upon the farm than to see you play the coward or traitor to save your property.'

"Michael, finding that he could make no impression upon the fears or the avarice of the boys, determined to carry their fortifications by storm. Accordingly he procured a heavy fence-rail, and commenced the assault upon the door. It soon came to pieces, and the upper logs fell out, leaving a space of about three feet at the top. Michael boldly entered the breach, when, by the articles of war, sticks were thrown aside as no longer lawful weapons. He was resolutely met on the half-demolished rampart by Peter Jones and William Smith, supported by James Griffin. These were the three largest boys in the school; the first about sixteen years of age, the second about fifteen, and the third just eleven. Twice was Michael repulsed by these young champions; but the third effort carried him fairly into the fortress. Hostilities now ceased for a while, and the captain and I, having levelled the remaining logs at the door, followed Michael into the house. A large three inch plank (if it deserve that name, for it was wrought from the half of a tree's trunk entirely with the axe), attached to the logs by means of wooden pins, served the whole school for a writing desk. At a convenient distance below it, and on a line with it, stretched a smooth log, resting upon the logs of the house, which answered for the writers' seat. Michael took his seat upon the desk, placed his feet on the seat, and was sitting very composedly, when with a simultaneous movement, Pete and Bill seized each a leg, and marched off with it in quick time. The consequence is obvious; Michael's head first took the desk, then the seat, and finally the ground (for the house was not floored), with three sonorous thumps of most doleful portent. No sooner did he touch the ground than he was completely buried with boys. The three elder laid themselves across his head, neck and breast, the rest arranging themselves *ad libitum*. Michael's equanimity was considerably disturbed by the first thump, became restive with the second, and took flight with the third. His first effort was to disengage his legs, for without them he could not rise, and to lie in his present position was extremely inconvenient and undignified. Accordingly he drew up his right, and kicked at random. This movement laid out about six in various directions upon the floor. Two rose crying: 'Ding his old red-headed skin,' said one of them, 'to go and kick me right in my sore belly, where I fell down and raked it, running after that fellow that cried "school butter."'*

* "I have never been able to satisfy myself clearly as to the literal meaning of these terms. They were

"'Drot his old snaggle-tooth picture,' said the other, 'to go and hurt my sore toe, where I knocked the nail off going to the spring to fetch a gourd of *warter* for him, and not for myself n'other.'

"'Hut!' said Captain Griffin, 'young Washingtons mind these trifles! At him again.'

"The name of Washington cured their wounds and dried up their tears in an instant, and they legged him *de novo.* The left leg treated six more as unceremoniously as the right had those just mentioned; but the talismanic name had just fallen upon their ears before the kick, so they were invulnerable. They therefore returned to the attack without loss of time. The struggle seemed to wax hotter and hotter for some time after Michael came to the ground, and he threw the children about in all directions and postures, giving some of them thrusts which would have placed the *ruffle-shirted* little darlings of the present day under the discipline of paregoric and opodeldoc for a week; but these hardy sons of the south seemed not to feel them. As Michael's head grew easy, his limbs, by a natural sympathy, became more quiet, and he offered one day's holiday as the price. The boys demanded a week; but here the captain interposed, and after the common but often unjust custom of arbitrators, split the difference. In this instance the terms were equitable enough, and were immediately acceded to by both parties. Michael rose in a good humor, and the boys were of course. Loud was their talking of their deeds of valor as they retired. One little fellow about seven years old, and about three feet and a half high, jumped up, cracked his feet together, and exclaimed, 'By jingo, Pete Jones, Bill Smith and *me* can hold any *Sinjin* [St. John] that ever trod Georgy grit.'"

considered an unpardonable insult to a country school, and always justified an attack by the whole fraternity upon the person who used them in their hearing. I have known the scholars pursue a traveller two miles to be revenged of the insult. Probably they are a corruption of 'The school's better.' '*Better*' was the term commonly used of old to denote a *superior*, as it sometimes is in our day: 'Wait till your betters are served,' for example. I conjecture, therefore, the expression just alluded to was one of challenge, contempt, and defiance, by which the person who used it avowed himself the *superior* in all respects of the whole school, from the preceptor down. If any one can give a better account of it, I shall be pleased to receive it."

## AN OLD FIELD SCHOOL, OR ACADEMY, IN VIRGINIA.

THE experience of one of that class of teachers, who found temporary occupation in teaching the children of one or more families of planters in Virginia and other southern states, will be found in the "Travels of Four Years and a Half in the United States (in 1798, 1799, 1800, 1801 and 1802), by John Davis." Mr. Davis was an Englishman of more than ordinary education and of social address, and while in this country numbered among his friends such men as Aaron Burr, President Jefferson, and other men of high political standing. He was a private tutor in New York, South Carolina and Virginia, and his graphic sketches of men and manners show some of the deficiencies in the means of education which even wealthy planters in the southern states experienced. With letters of introduction from President Jefferson he proceeds to the plantation of a Mr. Ball, and is engaged to teach his and his neighbors' children:

"The following day every farmer came from the neighborhood to the house, who had any children to send to my Academy, for such they did me the honor to term the log-hut in which I was to teach. Each man brought his son, or his daughter, and rejoiced that the day was arrived when their little ones could light their tapers at the torch of knowledge! I was confounded at the encomiums they heaped upon a man whom they had never seen before, and was at a loss what construction to put upon their speech. No price was too great for the services I was to render their children; and they all expressed an eagerness to exchange perishable coin for lasting knowledge. If I would continue with them seven years! only seven years! they would erect for me a brick seminary on a hill not far off; but for the present I was to occupy a log-house, which, however homely, would soon vie with the sublime college of William and Mary, and consign to oblivion the renowned academy in the vicinity of Fauquier Court-House. I thought Englishmen sanguine; but these Virginians were infatuated.

"I now opened what some called an academy,* and others an Old Field School;

* "It is worth the while to describe the academy I occupied on Mr. Ball's plantation. It had one room and a half. It stood on blocks about two feet

and, however it may be thought that content was never felt within the walls of a seminary, I, for my part, experienced an exemption from care, and was not such a fool as to measure the happiness of my condition by what others thought of it.

"It was pleasurable to behold my pupils enter the school over which I presided; for they were not composed only of truant boys, but some of the fairest damsels in the country. Two sisters generally rode on one horse to the school-door, and I was not so great a pedagogue as to refuse them my assistance to dismount from their steeds. A running-footman of the negro tribe, who followed with their food in a basket, took care of the beast; and after being saluted by the young ladies with the courtesies of the morning, I proceeded to instruct them, with gentle exhortations to diligence of study.

"Common books were only designed for common minds. The unconnected lessons of Scot, the tasteless selections of Bingham, the florid harangues of Noah Webster, and the somniferous compilation of Alexander, were either thrown aside, or suffered to gather dust on the shelf; while the charming essays of Goldsmith, and his not less delectable Novel, together with the impressive work of Defoe, and the mild productions of Addison, conspired to enchant the fancy, and kindle a love of reading. The thoughts of these writers became engrafted on the minds, and the combinations of their diction on the language of the pupils.

"Of the boys I cannot speak in very encomiastic terms; but they were perhaps like all other school-boys, that is, more disposed to play truant than enlighten their minds. The most important knowledge to an American, after that of himself, is the geography of his country. I, therefore, put into the hands of my boys a proper book, and initiated them by an attentive reading of the discoveries of the Genoese; I was even so minute as to impress on their minds the man who first descried land on board the ship of Columbus. That man was Roderic Triana, and on my exercising the memory of a boy by asking him the name, he very gravely made answer, Roderic Random.

"Among my male students was a New Jersey gentleman of thirty, whose object was to be initiated in the language of Cicero and Virgil. He had before studied the Latin grammar at an academy school (I use his own words) in his native state; but the academy school being burnt down, his grammar, alas! was lost in the conflagration, and he had neglected the pursuit of literature since the destruction of his book. When I asked him if he did not think it was some Goth who had set fire to his academy school, he made answer, 'So, it is like enough.'

"Mr. Dye did not study Latin to refine his taste, direct his judgment, or enlarge his imagination; but merely that he might be enabled to teach it when he opened school, which was his serious design. He had been bred a carpenter, but he panted for the honors of literature."

Mr. Davis accounts for his fidelity in teaching more hours than he was required to do by his contract, by his interest in the lessons of one of his female pupils:

"Hence I frequently protracted the studies of the children till one, or half past one o'clock; a practice that did not fail to call forth the exclamations both of the white and the black people. Upon my word, Mr. Ball would say, this gentleman is diligent; and Aunt Patty the negro cook would remark, 'He good cool-mossa that; he not like old Hodgkinson and old Harris, who let the boys out before twelve. He deserve good wages!"

"Having sent the young ladies to the family mansion, I told the boys to break up, and in a few minutes they who had even breathed with circumspection, now gave loose to the most riotous merriment, and betook themselves to the woods, followed by all the dogs on the plantation."

"There was a carpenter on the plantation, whom Mr. Ball had hired by the year.

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and a half above the ground, where there was free access to the hogs, the dogs, and the poultry. It had no ceiling, nor was the roof lathed or plastered, but covered with shingles. Hence, when it rained, like the nephew of old Elwes, I moved my bed (for I slept in my academy) to the most comfortable corner. It had one window, but no glass, nor shutter. In the night, to remedy this, the mulatto wench who waited on me, contrived very ingeniously to place a square board against the window with one hand, and fix the rail of a broken down fence against it with the other. In the morning, when I returned from breakfasting in the 'great big house,' (my scholars being collected,) I gave the rail a forcible kick with my foot, and down tumbled the board with an awful roar. 'Is not my window,' said I to Virginia, 'of a very curious construction?' 'Indeed, indeed, sir,' replied my fair disciple, 'I think it is a mighty noisy one.'"

He had tools of all kinds, and the recreation of Mr. Dye, after the labor of study, was to get under the shade of an oak, and make tables, or benches, or stools for the academy. So true is the assertion of Horace, that the cask will always retain the flavor of the liquor with which it is first impregnated.

"'Well, Mr. Dye, what are you doing?'

"'I am making a table for the academy school.'

"'What wood is that?'

"'It is white oak, sir.'

"'What, then you are skilled in trees, you can tell oak from hickory, and ash from fir?'

"'Like enough, sir. (A broad grin.) I ought to know those things; I served my time to it.'

"'*Carpenter.*—I find, sir, Mr. Dye has done with his old trade; he is above employing his hands; he wants work for the brain. Well! larning is a fine thing; there's nothing like larning. I have a son only five years old, that, with proper larning, I should not despair of seeing a member of Congress. He is a boy of genus; he could play on the Jews-harp from only seeing Sambo tune it once.'

"'*Mr. Dye.*—I guess that's Billy; he is a right clever child.'

"'*Carpenter.*—How long, sir, will it take you to learn Mr. Dye Latin?'

"'*Schoolmaster.*—How long, sir, would it take me to ride from Mr. Ball's plantation to the plantation of Mr. Wormley Carter?'

"'*Carpenter.*—Why that, sir, I suppose, would depend upon your horse.'

"'*Schoolmaster.*—Well, then, sir, you solve your own interrogation. But here comes Dick. What has he got in his hand?'

"'*Mr. Dye.*—A mole like enough. Who are you bringing that to, Dick?'

"'*Dick.*—Not to you. You never gave me the taste of a dram since I first know'd you. Worse luck to me; you New Jersey men are close shavers; I believe you would skin a louse. This is a mole. I have brought it for the gentleman who came from beyond sea. He never refuses Dick a dram; I would walk through the wilderness of Kentucky to serve him. Lord! how quiet he keeps his school. It is not now as it was; the boys don't go clack, clack, clack, like 'Squire Pendleton's mill upon Catharpin Run!'

"'*Schoolmaster.*—You have brought that mole, Dick, for me.'

"'*Dick.*—Yes, master, but first let me tell you the history of it. This mole was once a man; see, master (Dick exhibits the mole), it has got hands and feet just like you and me. It was once a man, but so proud, so lofty, so puffed-up, that God, to punish his insolence, condemned him to crawl under the earth.'

"'*Schoolmaster.*—A good fable, and not unhappily moralized. Did you ever hear or read of this before, Mr. Dye?'

"'*Mr. Dye.*—Nay (a broad grin), I am right certain it does not belong to Æsop. I am certain sure Dick did not find it there.'

"'*Dick.*—Find it where? I would not wrong a man of the value of a grain of corn. I came across the mole as I was hoeing the potato-patch. Master, shall I take it to the school-house? If you are fond of birds, I know now for a mocking-bird's nest; I am only afeared those young rogues, the school-boys, will find out the tree. They play the mischief with every thing, they be full of devilment. I saw Jack Lockhart throw a stone at the old bird, as she was returning to feed her young; and if I had not coaxed him away to look at my young puppies, he would have found out the nest.'

"I had been three months invested in the first executive office of pedagogue, when a cunning old fox of a New Jersey planter (a Mr. Lee) discovered that his eldest boy wrote a better hand than I. Fame is swift-footed; *vires acquirit eundo;* the discovery spread far and wide; and whithersoever I went, I was an object for the hand of scorn to point his slow unmoving finger at, as a schoolmaster that could not write. Virginia gave me for the persecutions I underwent a world of sighs, her swelling heavens rose and fell with indignation at old Lee and his abettors. But the boys caught spirit from the discovery. I could perceive a mutiny breaking out among them; and had I not in time broke down a few branches from an apple tree before my door, it is probable they would have displayed their gratitude for my instructions by throwing me out of my school-window. But by arguing with one over the shoulders, and another over the back, I maintained with dignity the first executive office of pedagogue.

"I revenged myself amply on old Lee. It was the custom of his son (a lengthy fellow of about twenty) to come to the academy with a couple of huge mastiffs at his heels. Attached to their master (*par nobile* *fratrum*) they entered without ceremony Pohoke Academy, bringing with them myriads of fleas, wood-lice, and ticks. Nay, they would often annoy Virginia, by throwing themselves at her feet, and inflaming the choler of a little lap-dog, which I had bought because of his diminutive size, and which Virginia delighted to nurse for me. I could perceive the eye of Virginia rebuke me for suffering the dogs to annoy her; and there lay more peril in her eye than in the jaws of all the mastiffs in Prince William County.

"'Mr. Lee,' said I, 'this is the third time I have told you not to convert the academy into a kennel, and bring your dogs to school.' Lee was mending his pen 'judgmatically.' He made no reply, but smiled.

"I knew old Dick the negro had a bitch, and that his bitch was proud. I walked down to Dick's log-house. Dick was beating flax.

"'Dick,' said I, 'old Farmer Lee has done me much evil—(I don't like the old man myself, master, said Dick)—and his son, repugnant to my express commands, has brought his father's two plantation dogs to the academy. Revenge is sweet—'

"'Right, master,' said Dick. 'I never felt so happy as when I bit off Cuffey's great toe and swallowed it—

"'Do you, Dick,' said I, 'walk past the school-house with your bitch. Lee's dogs will come out after her. Go round with them to your log-house; and when you have once secured them, hang both of them up by the neck.'

"'Leave it to me, master,' said Dick. 'I'll fix the business for you in a few minutes. I have a few fadoms of rope in my house—that will do it.'

"I returned to the academy. The dogs were stretched at their ease on the floor. 'Oh! I am glad you are come,' exclaimed Virginia; 'those great big dogs have quite scared me.'

"In a few minutes Dick passed the door with his slut. Quick from the floor rose Mr. Lee's two dogs, and followed the female. The rest may be supplied by the imagination of the reader. Dick hung up both the dogs to the branch of a pine-tree; old Lee lost the guards to his plantation; the negroes broke open his barn, pilfered his sacks of Indian corn, rode his horses in the night—and thus was I revenged on Alexander the coppersmith.

"Three months had now elapsed, and I was commanded officially to resign my sovereign authority to Mr. Dye, who was in every respect better qualified to discharge its sacred functions. He understood tare and tret, wrote a copper-plate hand, and, balancing himself upon one leg, could flourish angels and corkscrews. I, therefore, gave up the 'academy school' to Mr. Dye, to the joy of the boys, but the sorrow of Virginia."

Whilst schools were thus poorly equipped and the instruction given was thus defective in its methods and meagre in its extent, it becomes of interest to inquire whence such a measure of general intelligence and so many individual cases of attaining to an eminent position in society. This was the result of no single cause alone, but of a variety in combination.

The first of these that may be named, both in its influence upon childhood and upon manhood, was the necessity of a hard fought battle for existence, but relieved by the assurance that victory would be the reward of persistent exertion. Its results were robustness, patience of toil, resoluteness and perseverance in encountering difficulties, and fertility of resources. The rustic lad,—and making the necessary variations, we include the female sex with the representative male,—the rustic lad who had been trained to help his parents from the moment he had acquired strength to steady his steps, to toil on all the same whether the bright sun cheered him or the chill air benumbed his limbs; whether his tasks were varied, pleasant and light, or, on the contrary, he had learned patience, marching beside the patient ox all the long hours of a long spring day, the animals only alternating with others which served as relays; and had been no stranger to such discipline as picking stones in the stubble whilst the sad heavens distilled a drizzly rain, they condensing all their gloom in his soul, but withheld those large and frequent drops which would have been the signal of his release; and among the least severe of whose lessons in acquiring hardihood had been, in gathering the fruits of autumn, to face its frosts without mittens or shoes; this lad found nothing in the difficulties of the school-room to appall him, and storms and deep drifts rather added zest to his daily walks. No unintelligible jargon of the spelling book, no abstruse section in his reader, was an overmatch for his industry.

True, he did not understand all he studied, but he learned to spell and to read and to commit to memory what was assigned him. And when he took his arithmetic, which contained only definitions, rules and examples, although his teacher vouchsafed him little explanation, he had perseverance enough to ponder every dark process till light broke through. And there were instances of boys who worked for consecutive hours and days at problems confessedly some of the most knotty that could be found, till at last their unaided exertions were rewarded with success, which brought more exquisite joy than ever thrilled the finder of a rare gem. These exceptional cases stimulated the more dull, and most became possessed of at least the rudiments of the science, quite sufficient for practical life, or which under the stimulus of necessity became subsequently enlarged to that extent. In manhood no blind adherence to traditional methods was or could be observed. Emergencies were constantly arising which taxed ingenuity to the utmost in devising the fitting expedients to meet them. It was a daily study to make the narrowest means serve the same ends as the amplest. Hard thought was expended without stint upon labor-saving processes, improvements and inventions. Thus was gained a discipline of mind beyond what the higher college mathematics usually imparts, and ofttimes a readiness in applying mechanical principles, of which many an engineer trained in the schools is utterly devoid, however prompt he may be in the routine to which he is accustomed.

The family training, aside from the inuring of children to patient industry, contributed greatly to their profiting from their school privileges. To do or not to do was not then left so generally to the child's pleasure. He was made to obey before he had experienced the delight of carrying into effect his own will in opposition to that of others; and thus was formed the habit of unquestioning compliance with the requirements of parents. When the child could understand the subject, he was taught that however irksome at times were the tasks imposed upon him, it was only in virtue of the allotment that man was to eat bread by the sweat of his brow, and that only by a cheerful performance of what was within his power could he make a return for the care he was continually receiving. Thus from a sense of religious and filial obligation the rigor of their early discipline was the more easily sustained. Self-control and a certain measure of self-reliance were results of the discipline of infancy even; and in advancing childhood it was inculcated in the house and in the field, that each must depend upon himself for whatever he was to be and to possess in life. And knowledge, knowledge that was not the mere blind recipient of instruction, intelligent knowledge which perceived relations, and reasoning knowledge which could make the practical application as opportunity served, was set forth as the condition indispensable to render exertion successful. Hence it was a prized privilege to go to school, as well as a pleasant exchange for physical toil for a brief period, an exchange of work at home for another variety of work in the school-room, not of one manner of busy idleness and mischief for another. Also in many cases the home was itself a school, and either that knowledge was there gained which others acquired at school, or study was further pursued under the guidance of parent, or brother or sister, who by some happy gift of Providence had required little tuition. Often also, winter evenings or other hours, when the labor of one pair of hands might be spared, were passed in the social reading of instructive books.

The listening every seventh day to two discourses, wherein were discussed the deepest theories which can be proposed to man, may be named as an additional item in the answer to our inquiry. The clergymen of that day had received the best education that the country afforded, and were daily cultivating intimacy with the profoundest theologians. Thus they had ever thoughts which they had originated or had made their own to present. And these thoughts were inwardly digested by a goodly number of their hearers, and becoming a part of their being, they too

> "reasoned high
> Of Providence, foreknowledge, will and fate,
> Fixed fate, free will, foreknowledge absolute;"

and if they "found no end," they were not "in wandering mazes lost," for, unlike the lost angels, they ruled their discussions by the infallible word of inspiration. It cannot be said that serious thought then bored, or that the sparkle of the unsubstantial poem chiefly drew, or that triviality was the characteristic of the multitude.

The study of one book, and that the Bible, simple enough in parts to meet the understanding of the little child, and of interest enough to absorb his attention, and in other parts of depths which no finite intellect can sound, and everywhere wise above the wisdom of men, and without any alloy of error, was one of the most efficacious means of raising the mass of the people in intelligence, and in educating a few, who made it their constant meditation, to a nicety of discrimination and a profundity of thought truly wonderful. Take as an example one silvery haired man whose memory is cherished with veneration. His school privileges had been less even than the scanty amount of most of his contemporaries, hardly amounting to three winter schools in all. Moreover, weakness of the eyes almost cut him off from reading books and papers throughout his life. But he was able to read daily a few verses, sometimes several chapters, in his large quarto Bible, and when he read aloud, all untaught as he was, he read with a naturalness and gave the sense, so that the hearer marvelled. Comparing scripture with scripture, he had attained to a skill in interpreting which seldom erred. His quickness in detecting a fallacy or in observing a doctrine which harmonized not with the living oracles was surpassed by very few of even the most highly educated of schoolmen. He was exceedingly retiring, but to the few who knew him, his life and his language seemed as correct as the words of that book on which both, with perfect naturalness, without any tinge of formality or quaintness, were modeled. Who will venture to say that this man's education was not incomparably superior to that of him who has delved a whole life in conflicting systems, who has sought to know the thoughts of all reported as great, but who has settled nothing for himself?

The political principles which found their expression in the declaration of independence, and which were a cherished inheritance from the fathers, leading to a general participation in the government of the country, and producing the habit of earnestly debating every question of public concern, had no small share of influence in exciting intensity and energy of mental action. By the fireside, in the field, at the corners of the streets, in the shops and stores, those powers were developed which had further exercise in the town meeting, and carried their possessor to some humble position of trust or authority; and when here trained and shown to be capable of sustaining higher responsibilities, advanced him again, so that he who had forged iron chains, was chosen to fashion the more efficacious restraints of laws; he who had occupied the cobbler's seat, was promoted to the bench of justice; and he who had been wont to rule oxen was thought worthy to govern men.

The newspaper, and the family, and the village library contributed largely to the general intelligence. The weekly paper furnished no small part of the topics of conversation in the family and among neighbors, and, in particular, supplied the pabulum for political discussions. The few books owned or borrowed were carefully read again and again. The small proprietary libraries furnished some of the most valuable histories and the choicest works in belles-lettres. It was not of rare occurrence to find persons who showed familiarity with Rollin, Ferguson, Gibbon, Robertson, and Hume; and sometimes one might even be met, who could give an orderly account of an entire work of these authors; and there were many who could repeat favorite poems, peradventure even the entire *Night Thoughts* of Dr. Young, if that was the chosen *vade mecum.* Even some children of twelve or fifteen years of age,—barefoot boys who had only "noonings" and the time they might gain by manual dexterity in accomplishing their "stents,"—had perused several of the voluminous historians named above. How will such lads compare in mental strength and vigor with children who willingly read nothing but the most exciting tales or the most intellectual pap made toothsome?

The observation of men and of nature, pursued to good advantage where no unbending usages restrained free development of character, no wrappings of conventionalities gave a uniform semblance to all, where the woods and the waters and the inhabitants thereof had only begun to recognize the dominion of man, quickened too by the necessity of turning to account every item of knowledge that could be gained, was an ample equivalent for the more comprehensive speculations of mental philosophy and the scientific nomenclatures and descriptions of natural history to be learned from the mouth of the lecturer.

Finally, those defective schools of the past generation did place the key of knowledge in the hands of the inquisitive; which is nearly all that the schools can now do.

## CHAPTER IV.

### PROGRESSIVE DEVELOPMENT OF SCHOOLS AND OTHER INSTITUTIONS OF PUBLIC INSTRUCTION.

#### INTRODUCTION.

By common or public schools in this chapter is understood that grade or class of educational institutions which the State provides or secures for all its children, in the rural districts as well as in the crowded city, wherever a human being is to be found on its territory capable of receiving that formal instruction which is essential to the healthy physical, moral, and intellectual growth of each individual, and to the attainment of that amount of knowledge which the performance of every day business and the universal duties of citizenship require. It is common, because it is the debt which the community owes to every citizen for their good and its security. It is public, because it is established by the State through agencies of its appointment or providing, conducted according to the rules of its prescribing or authorization, supported by funds protected or furnished by its legislation, accessible to all pupils upon terms of equality, and subject to such inspection as the law may institute. It is not necessarily gratuitous; it may be free or cheap—but it can not be common if the cost is beyond the reach of the poorest. Although public, it is not beyond legal control. It is everywhere subject to such limitations as to age, attendance, studies, books, and teachers as the State may prescribe; and it must exist by force of law, general or special, and be managed by agents who have their authority direct or indirect from legal provisions, and its privileges must be open to all children on equal terms. It is no longer limited in its range of instruction to the few elementary studies, or to mere children. Studies which formerly belonged to the academy or college are now parts of the curriculum in the higher classes or grades of the common school, especially in cities and large villages.

Although originating at different times, and projected after different models, and modified by differing conditions of nationality, occupation, and religious opinions or practices, the American Common or Public School, however widely separated in territory, is now subjected to common social and political influences, and is fast approximating to a common organization, and to similar, and almost identical systems of administration, instruction and discipline. It is doubtful if the institution attains its highest efficiency and broadest usefulness, by this legal uniformity. Large bodies of children will be thrown out of its influence altogether; bitter antagonisms between bodies of citizens will be engendered; and the teaching power of the schools will not find that field and stimulus for individual expansion and original methods and special adaptations, which greater liberty of instruction, and more diversified preparation and administration would create. It is not impossible that the recent rapid approach to uniformity in organization, administration, instruction and discipline, will be arrested and modified by the independent action of State and city systems, as soon as each becomes again more subject to peculiar local influences.

The constitutional provision of any State is indicative only of the policy of a comparatively few men on the subject of schools and education, and is mainly serviceable in protecting funds specially appropriated to these purposes from being devoted to other objects, and in giving the friends of these interests a firm ground to stand on in their advocacy of the same. The constitutions and school acts since 1865 in the States recently engaged in the rebellion, and prostrated in its suppression, have been adopted for the protection of the enfranchised colored population, and are not in harmony with the former habits and present convictions of a large majority of the old voters. It will take years before this great interest of schools and education can get adjusted to the new relations of parties, and firmly established in the habits of society.

We shall now proceed to give a comprehensive survey of the progressive development of Common or Public schools in each State, and at the same time indicate at least statistically, the condition of the State in respect to other educational institutions and agencies. For convenience of reference we shall present the States in their alphabetical order and not in the more logical order of the chronological establishment and development of schools in the same. To appreciate the greater or less rapidity and efficiency of the movement we shall indicate the date of settlement, the organization of the government, the growth of population, and the resources of each State, and the latest statistical results.

## I. ELEMENTARY INSTRUCTION.

### ALABAMA.

Alabama belonged to the State of Georgia till 1802, when by cession it became part of the Territory of Mississippi until 1817, when it was organized as an independent Territory, and admitted a State in 1819, with a population in 1820, 127,901; which had increased in 1870 to 996,992, (475,510 colored); on an area of 50,722 square miles; and taxable property to the value of $157,770,387.

The earliest constitution of Alabama (1819) ordains that 'schools and the means of education shall forever be encouraged,' and the General Assembly is directed to protect (1,) the land grants of the United States for the use of schools within each township; and (2,) the Seminary lands 'for a State university for the promotion of the arts, literature and science.'

The Constitution of 1867 ordains the appointment of a Superintendent of Public Instruction,— elected at the same time and in the same manner as the Governor, and of a Board of Education, consisting of the Superintendent and the Governor *ex-officio*, and two members elected for a term of four years, for each Congressional District. The Board of Education is declared a body corporate and politic, 'with full legislative powers in reference to the public educational institutions of the State, and its acts when approved by the Governor, or when reënacted by two-thirds of the Board in case of his disapproval, shall have the effect of law, unless repealed by the General Assembly.' This Board of Education is constituted a Board of Regents for the State University, and when sitting as such, has power to appoint the president and faculty. Of the Board of Regents, the president of the University is, *ex-officio*, a member for consultation. To the support of public schools the constitution continues the appropriation of all lands and other property donated to the State by the United States and individuals for educational purposes, and one-fifth of the aggregate annual revenue of the State, and of any specific tax which the General Assembly may levy upon all railroad, navigation, banking and insurance companies, foreign or domestic, doing business in the State.

The peculiar legislative and administrative school authorities provided by the State in the constitution of 1867, has not had thus far, a favorable field, or sufficient time to develop its legitimate results. The attempts to establish an efficient system of public schools, based on the original U. S. township land grants (16th section), by ordinary legislation, from the first State law of 1823 down to 1854, had entirely failed. In the year last named, to give efficiency to previous laws, a State Superintendent was appointed, additional resources were provided by setting aside the income of the U. S. Surplus Revenue fund deposited with the State, and the avails of certain swamp lands, and a direct appropriation of $100,000 out of the aggregate annual State tax. Under the active labors and legislative reports of the Superintendent, the holding of Teachers' Institutes, the meetings of a State Educational Association, the circulation of monthly issues of an Educational Journal, an intelligent public opinion was being created, and school officers were being educated to their work, when the war of Secession arrested the work of peace. The annihilation of all personal property, and the revolution of the old social and industrial system of the South which followed, has left a *debris* to be cleared away before any general system of education adapted to the new order of society can be organized and put in efficient operation.

Under the legislative authority vested by the constitution in the Board of Education, and under the administration of a Superintendent of Public Schools, elected by the people for four years, a system has been instituted which in most of its features corresponds to that which was growing up out of the legislation of 1854, and for its support the superintendent in his report for 1871 estimates that the sum of $700,000 will be available in 1872.

To assist the reorganization of public schools in Mobile, Montgomery, Selma, Huntsville, La Fayette, Girard, and Columbiana, aid was extended by the agent of the Peabody Fund to the extent of about $5,000 in 1871.

The census of 1870 returned 77,139 in school attendance, out of 342,976 of the school age (5 to 18 years); and 349,771 persons over 10 years who could not read, and 383,012 who could not write. Out of 2,969 schools of all kinds, with 75,866 pupils, 57 are returned as classical colleges and academies, with 3,218 pupils, and 2,812 public schools, with 67,000 pupils.

## ARKANSAS.

POPULATION—In 1840, 97,574; in 1870, 484,471—*race*, 362,115 *w.*; 122,169 *c.* AREA—52,198 sq m.; *persons to s. m.*, 9.30; families, 96,135; *pers. to fam.*, 5.04; dwellings, 98,195; *per. to dw.*, 5.20; persons between 5 and 18, 84,645 *m.*, 80,845 *f.* Taxable property, $94,168,843.

Arkansas was organized a Territory in March, 1819, and admitted a State in 1836.

The constitution of 1836 ordains that the General Assembly, in consideration that 'knowledge and learning generally diffused throughout a community are essential to the preservation of a free government,' shall provide by law for the school lands, and 'encourage intellectual, scientific and agricultural improvements.' The State received 886,460 acres of land for common schools, and 46,080 for a university, but the legislature did not come up to the above requirements of the above fundamental ordinance, and no serious, or at least no successful attempt was ever made to inaugurate a system of public schools. In 1854 the Secretary of the State, who was *ex-officio*, State Commissioner of Common Schools, reported only 40 public schools, and complains of 'the indifference that pervades the public mind on the subject of education.' Owing to this indifference, and fraudulent and defective legislation, the munificent land grants of the general government have been squandered, and the permanent school fund from these sources in 1870 was $35,192, instead of $2,000,000 or $3,000,000, as might have been realized under honest and judicious management.

The constitution of 1868 ordains that 'the General Assembly shall establish and maintain a system of free schools for the gratuitous instruction of all persons in the State between the ages of five and twenty-one years,' and for their supervision, 'a superintendent and such other officers as may be necessary, shall be appointed.' A State university, 'with departments for instruction in teaching, in agriculture and the natural sciences shall also be established and maintained.' 'To support these institutions, the proceeds of all school lands and other property before donated, or which may be donated to the State for educational purposes, shall constitute a School Fund, the annual income of which, together with one dollar *per capita* annually assessed on every male inhabitant over the age of 21 years, and so much more of the ordinary annual revenue of the State as shall be found necessary, shall be faithfully appropriated to the free schools and universities, and to no other purpose whatever.'



In view of these provisions, a school system was established in 1869, the authorities of which are: (1,) a State Superintendent, elected every four years; (2,) a Circuit Superintendent, appointed by the Governor for each judicial district, of which there are ten; (3,) a State Board of Education, composed of the State and Circuit Superintendents; (4,) a single trustee for each school district, and (5,) a city Superintendent for each incorporated city. The Circuit Superintendent gives his entire time to the interests of the schools, holds a Teachers' Institute in his district every year, examines all candidates for the office of public school teacher, and issues three grades of certificates—the first of which is valid in his district for 2 years, the second for 1 year, and the third for 6 months.

The report of the Superintendent to the Governor at the close of 1870, made a very fair exhibit of schools, teachers and expenditures compared with any thing before published. In the two years 1869 and 1870, 657 new school-houses have been built, making in all 1,289; of 182,474 children (white and colored) between the ages of 5 and 21, 107,908 have attended school of some kind; 2,537 schools had been taught by 2,302 teachers, of whom 944 attended the 41 Teachers' Institutes which had been held. The entire sum expended for the public schools was $583,844, of which $334,952 was from direct tax.

The *Arkansas Journal of Education* was established in 1870, and made the organ of the State Board in 1871. A State Teachers' Association was organized in 1869, and has held three annual meetings. The Peabody Fund furnished aid in 1870 to the amount of $9,450.

The National census for 1870 returns 1,978 schools of all kinds, under 3,008 teachers, of whom 992 were females. Of these schools 1,744 are public, with 1,966 teachers and 72,004 pupils. Under the head of classical, professional and technical institutions, there are 8 colleges (*so-called*), 46 academies, 1 school of theology, 1 of medicine and one for the blind and deaf mutes.

These statistics returned for some States would be significant, but names are not things, or at least schools, in the light which official reports throw on their actual condition in Arkansas, especially when the same census returns 111,799 persons over 10 years old who can not read, and 133,339 who can not write.

### CALIFORNIA.

POPULATION in 1850, 92,597; in 1870, 560,247; *race*, 499,424 *w.* and 4,272 *c.* AREA, 198,181 *sq. m.*; persons, 2.29 to *sq. m.*; families, 128,752; *persons to a fam.*, 4.35; dwellings, 126,307; *pers. to a dw.*, 4.44; persons 5 to 18, 71,086 *m.*, 66,043 *f.* Taxable property, $269,644,068.

California was settled by the Spanish as early as 1769, and became part of the territory of the United States by treaty with Wisconsin in 1848, and was admitted into the Union in 1850.

The constitution of 1849 provides for the election by the people of a superintendent of public instruction, and enjoins on the legislature 'the establishment of a system of common schools, by which a school shall be kept in each district at least three months in each year,' and deprives each district which neglects to do so, of its share in the interest of the public fund during such neglect. The proceeds of all lands donated by the United States Government for school or university purposes, including 500,000 acres donated for internal improvements, are to be set aside inviolably and without diminution for such purposes and no other. Under this injunction and wise legislative counsels, a system of public schools was at once established, and within the last ten years has been developed into proportions and efficiency, especially in the large towns, which may challenge comparison with any in the country. Without noticing the successive enactments, many of them important, by which the system was developed, we find in the constitution, and revised school law of 1866 the following features:

1. A State Superintendent, elected for a term of four years by the people.

2. A State Board of Education, consisting of the Governor, the State Superintendent, the Principal of the State Normal School, the Superintendent of the city and county of San Francisco, and of the respective counties of Sacramento, Santa Clara and San Joaquin, and two professional teachers holding State certificates of competency and experience, nominated by the State Superintendent and elected by the Board. To this Board is assigned the duty of 'adopting a course of study, and rules and regulations for all public schools, to prescribe a uniform system of text-books, and a list of books suitable for school libraries, to grant diplomas to teachers and regulate their examinations.'

3. A County Superintendent for each county, elected at the general election, to hold office for two years, who must visit all the schools in his county at least once a year, distribute and see to the enforcement of all regulations and circulars of the State Board, hold Teachers' Institutes, keep on file the State Educational Journal, and all printed reports and documents of the Superintendent, and all reports of school officers and teachers, as well as an official record of his own doings and of the county board of examination, on the penalty of a forfeiture of $100 from his official salary in case of failure.

4. Three trustees for each school district, one elected each year and holding office for three years, to whom the local management of the school, as to teachers, books and school-houses belongs, subject to the regulations of the State and county officers.

The law provides for a State Normal School, Teachers' Institutes, and State and County Boards of Examination composed of teachers, exclusively. It also deals specifically with many points which are left doubtful or discretionary in other States, such as: a gradation of schools into primary, grammar and high; a limitation of school hours for children under eight years to four hours, and for all schools to six hours, a school month to twenty school days, or four weeks of five school days; making the parents of pupils liable for damages to school property of any kind; making profanity and vulgarity good cause for suspension, and continued willful disobedience and open defiance of the teacher's authority, good cause for expulsion; exempting all teachers from professional employment on days as may be declared public holidays, State or national; the necessity of teachers attending the Institute for their county, and of the State Superintendent subscribing for a copy of an Educational Journal in which the official circulars, decisions and laws relating to schools are published, for each county and city and district officer. Teachers are enjoined 'to instruct their pupils in the principles of morality, justice, and patriotism, and to train them up to a true comprehension of the rights, duties, and dignity of American citizenship.'

According to the official reports, there were in 1870, 1,354 public schools, under 1,687 teachers (961 females), maintained at a total expenditure of $1,290,585, of which $847,229 was raised by tax. The productive capital of the school fund is $2,000,000.

The census of 1870 returned 24,877 persons over 10 years old who could not read, and 312,716 who could not write.

CONNECTICUT.

Connecticut on becoming a State continued the educational policy commenced in the colonial law of 1650, and much earlier in the original towns, which composed both the colonies of Connecticut and New Haven—in all of which schools were instituted within *one year* after the first settlements were made. At the beginning of this century the system of public instruction embraced (1,) a common school in every neighborhood where at least twelve children could be gathered for elementary instruction; (2,) an endowed grammar school, or incorporated academy, in the county town, or one or more private schools for classical instruction in all the large parishes of the State; (3,) a college for superior instruction at New Haven, with special reference to the ministry, and the 'learned professions' of law and medicine. The common school authorities were: (1,) a school committee (of three persons) for each school society (which corresponded to the parish—and of which there was one or more for each town,) which looked after the financial affairs; (2,) a district committee, appointed by the society, for each district, to employ the teacher and look after the local matters; and (3,) school visitors, (of which the clergyman was always a member) whose business it was to visit the schools and certify to the competency of the teachers.

The State exercised its direct authority in the supervision of the common schools for the first time in 1838, when, under the lead of Henry Barnard, a member of the Legislature from Hartford, a State Board, entitled Commissioners of Education, was instituted, with a secretary as its executive officer. The duties of the board were mainly to collect and disseminate information and awaken public interest in behalf of the schools, and the means of popular education generally. Out of the action of that board, and of the Massachusetts Board of Education established in 1837, have been developed the measures of educational reform and the systems of public instruction which now exist in every one of the United States.

I. The system of Common Schools in Connecticut is administered by (1,) State Board of Education, composed of the Governor, Lieut. Governor, and four persons, one from each Congressional district, and charged with the general supervision and control of the educational interests of the State, with special power to prescribe what books shall be used, but not to require any book to be changed oftener than once in five years; to prescribe the form of all school reports; to establish and manage a State Normal School, and hold conventions of teachers; and to appoint a secretary, whose business it is made to exercise a general supervision over the public schools, to visit different parts of the State for the purpose of awakening and guiding public sentiment in relation to the practical interests of education, to collect school-books, apparatus, maps, and charts as can be obtained without expense to the State, and to report annually to the board on the condition of Normal schools and other public schools of the State.

(2,) A Board of School Visitors for each town, of six or nine members, as the town may determine, who prescribe regulations for the management, studies, classification, and discipline of the public schools; examine candidates and issue certificates of qualifications to such as they find qualified. If authorized by the towns, this board may employ the teachers for the schools; visit the schools through one or more of their members, called an acting visitor or visitors; and report to the town and the board annually, and when required.

(3,) A committee of each district, charged with all matters of local management, unless the same shall have been transferred by the town to the school visitors.

The law designates certain branches in which the teachers must be found qualified to teach, and which any parent may require his child, if properly qualified, to receive instruction, viz., reading, writing, arithmetic, and grammar thoroughly, and the rudiments of geography, history, and drawing.

From the year 1650, it has been made by law the duty of all parents and guardians of children 'to bring them up in some honest and lawful calling, and to cause them to be instructed,' originally 'to read the Holy Word of God and other good laws of the colony,' but by existing statute 'in reading, writing, English grammar, geography and arithmetic.' By the existing law, 'any child between the ages of 8 and 14 must attend some school, public or private, or be instructed at home, at least three months in each year, unless the physical or mental condition renders such instruction inexpedient. And no child under 14 can be employed to labor in any business, whatever, unless he has attended school three months out of the twelve preceding, under a penalty of $100 for each offense. Each city or town may make all needful regulations concerning habitual truants from school, or children under 16 years of age found loitering during school hours, with prescribed modes for their arrest, penalties, and for repeated convictions, their sentence to the State Reform School, and in case of girls, to the Girls' Industrial School. To carry out these provisions relative to children engaged in factory labor, the State Board appoint an agent who visits the localities, confers with employers and teachers, and thus, without actually appealing to penalties, secure the enforcement of the law. But the statistics of the Secretary's report for 1872, and the national census of 1870, show that the aim of the law—universal school attendance, and universal elementary instruction at home or at school, are not now reached. The census shows that there were 29,616 persons over 10 years old, of all races, who were returned as illiterate—over 19,000 who could not read, and over 29,000 who could not write. Of the 29,616 thus returned, 27,913 were white, and of these 5,678 were native born. Out of 131,748 persons over 4 and under 16 years of age in January, 1872, only 83,095 were registered as scholars in public schools in the summer of 1872, and 94,408 in the winter of 1872. If to these we add 8,754 in private schools, it leaves 11,947 not in any school, public or private.

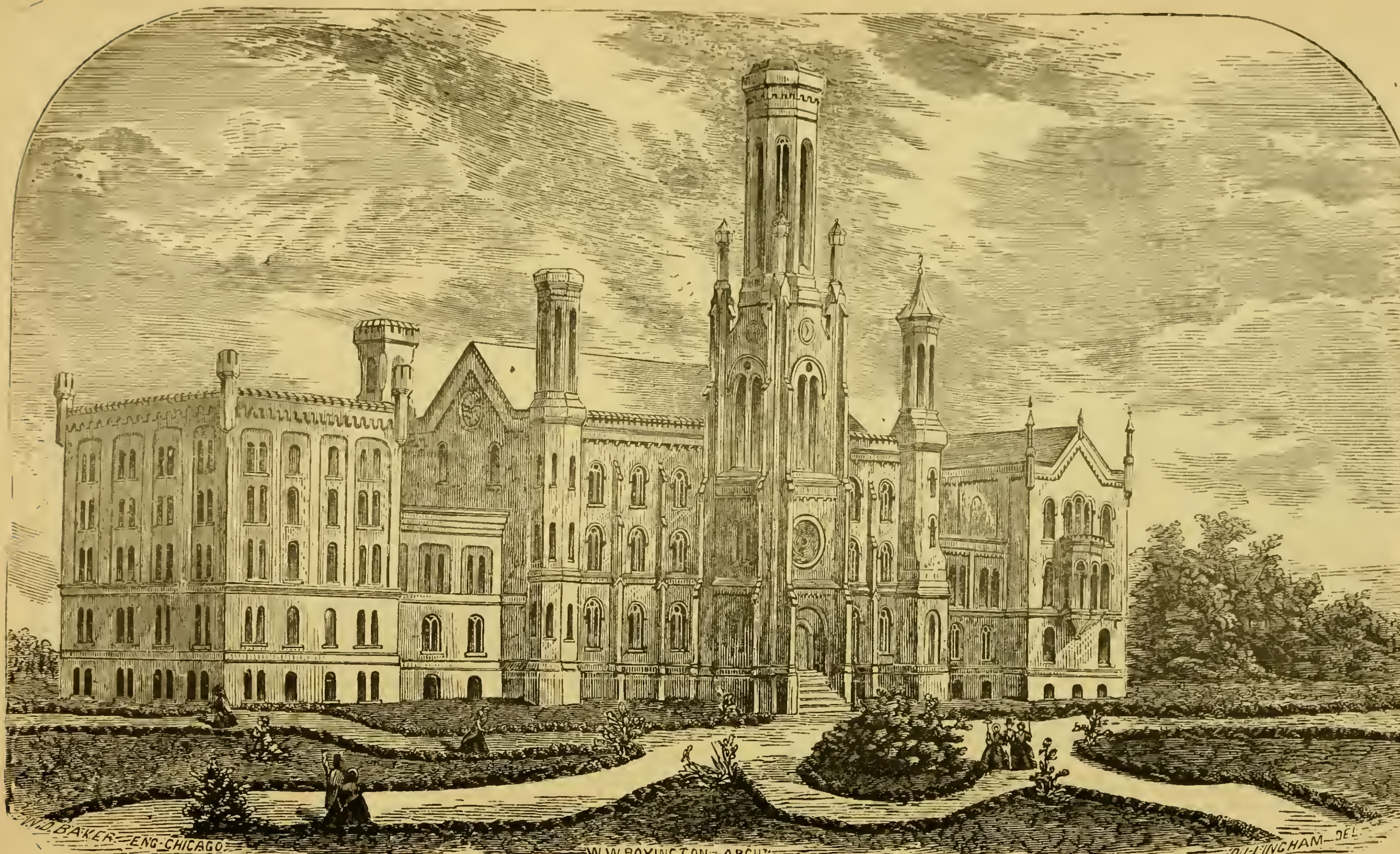
In 1871, there were 166 towns; 1,535 school districts, with 1,630 schools, classified into 2,290 departments, under 2,420 teachers (2,194 females), of whom 595 had not taught before; the State School Fund, $2,048,375; Town Deposit Fund, $763,661; Local School Fund, $150,000; valuation of taxable property, $322,553,488. The income in 1871 was, from permanent funds, $183,262; from town and district taxation, $1,052,545; from rate-bills, $267,809,—total $1,503,617.

The educational institutions of the State in 1872 consisted of (1,) 1,630 common schools; 100 academies, seminaries, and high schools of secondary instruction; 3 colleges, 8 professional and special schools, 1 teaching, 3 theology, 1 law, 1 medicine, 1 science applied to engineering, agriculture, and architecture, 1 art—industrial and ideal, 1 deaf mute, 1 imbecile, and 290 private schools of every grade and aim.

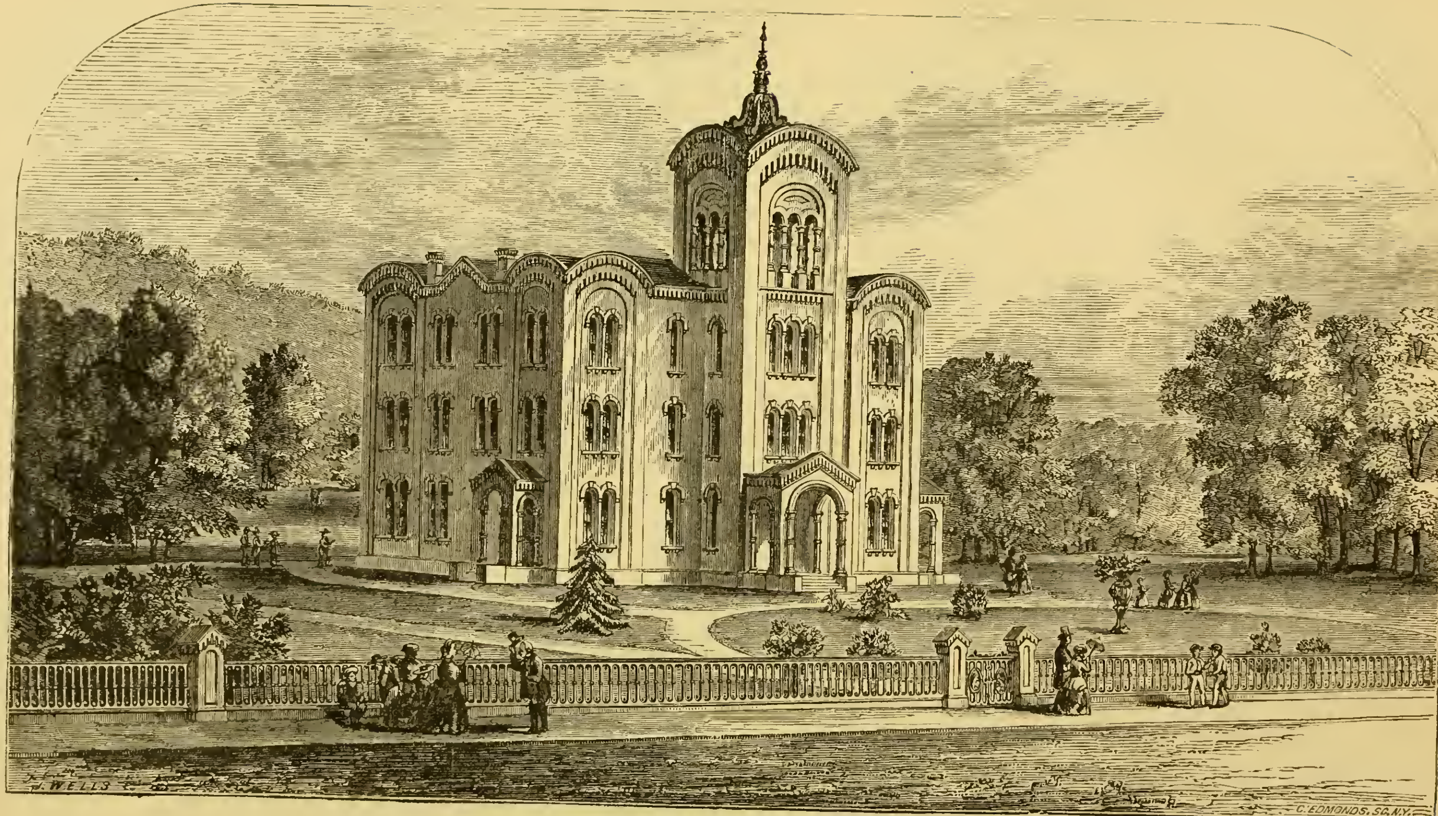
### DELAWARE.

Delaware was the first State to ratify the Federal Constitution (1789), and one of the earliest to ordain by constitution (1792) that 'the Legislature shall, as soon as conveniently may be, provide by law for establishing schools and promoting arts and sciences.' But the act of 1796 'to create a fund sufficient to establish schools,' and all subsequent acts of 1797, 1816, 1817, 1821, 'to increase the fund or pay the tuition of poor children,' or of 1829 'to provide for free schools,' or of 1830 and 1832, 1833 and 1835 supplementary and additional thereto, or of 1837 appropriating the income of the U. S. Surplus Revenue Fund for the benefit of the school districts, and all subsequent acts (1852, 1857, 1858, 1861) have failed to go to the root of the matter by making it obligatory on the towns or hundreds to establish and maintain public schools, not for the poor, but for all classes, and to raise by tax on the taxable property of such town or hundred, a minimum sum for the support of such schools, and then subjecting teachers to an examination, and the schools to regular visitation, by a committee responsible to the State and to the local community for the performance of their duties. From this general remark should be excepted the city of Wilmington, in which a system of public schools has been maintained under a special act of the Legislature, by which the school interest is committed to a board elected by the citizens, with power to establish schools and provide money for their support, by requisition on the city authorities. Down to 1872, no provision was made by the State for education of the colored children, but by the aid of citizens, and the Freedmen's Bureau, 29 schools were maintained with 2,104 pupils at an expense of $11,000.

According to the national census of 1870, out of a school population (5 to 18 years of age) of 40,807, only 19,965 were returned at school in the year previous, and out of the total population (125,015), 19,356 persons over 10 years could not read, and 23,100 could not write. According to the same census there were 326 public schools under 388 teachers, with 17,835 pupils; 9 academic institutions under 63 teachers and 859 pupils (including 2 classed as colleges with 15 teachers, of whom 8 are females, and 137 pupils, of whom 120 are females; and 38 private and parochial schools, with 59 teachers and 1,881 pupils.




CHICAGO CITY UNIVERSITY.




NORWICH (CONN) FREE ACADEMY.

### FLORIDA.

Florida was admitted into the United States in 1845, although settled earlier than other portions of the Union. Although the Constitution adopted in 1839, and that of 1865 throw their protection around lands granted 'for the use of schools and seminaries of learning,' not much seems yet to have come of the lands (amounting to over 1,000,000 acres), or to have been done for schools, until under the act of Jan. 30, 1869, by which (1,) a Superintendent of Public Instruction is appointed for the State, and (2,) County Superintendents for each.

According to the national census of 1870, out of a school population (5 to 18 years of age) of 63,807, 12,778 were returned as attending school in the year previous. Of this number, 8,254 were white and 4,524 colored. Out of the entire population (187,748), 66,238 persons over 10 years of age could not read, and 71,803 could not write, with taxable property to the valuation of $32,-480,843, and school lands yet undisposed of. A better exhibit may be anticipated in 1880 over 1870, when the census returned 377 public schools, with 14,000 pupils; 10 academies, with 580 pupils, and 141 private schools, with 1,500 pupils.

### GEORGIA.

Georgia was one of the earliest to assert in its fundamental law (Constitution of 1777), that 'schools shall be erected in each county, and supported at the general expense of the State,' and to make liberal appropriations to endow seminaries of learning. In 1783 the legislature donated 1,000 acres of land to each county for the support of free schools, and in the year following, 40,000 acres for the endowment of a university, and in 1792, one thousand pounds for the endowment of an academy in each county. In the preamble of the charter creating the University of Georgia in 1785, are these words: 'as it is the distinguishing happiness of free governments that civil order should be the result of choice, and not necessity, and that the common wishes of the people become the laws of the land, their public prosperity and even existence depend very much on suitably forming the minds and morals of their citizens. * * * It should be among the first objects of those who wish well to the national prosperity, to support the principles of religion and morality, and early to place the youth under the forming hand of society, that by instruction they may be molded to the love of virtue and good order. Sending them abroad to other countries for an education will not answer.' To give effect to the last suggestion, in the same year it was enacted that 'if any person or persons under the age of sixteen years, shall, after the passage of this act, be sent abroad without the limits of the United States, and reside there three years for the purpose of receiving an education under a foreign power, such person or persons, after their return to this State, shall for three years be considered and treated as aliens, in so far as not to be eligible to a seat in the legislature or executive authority, or to hold any office, civil or military, in the State for that term, and so in proportion for any greater number of years as he or they shall be absent as aforesaid.' The Legislature at this period was in earnest, and comprehensive in its educational policy. In spite of numerous laws and liberal appropriations designed to provide free elementary instruction for the poor, to establish at least one endowed academy in each county, and a university for higher and professional learning for the whole State, the hindrances incident to a new country, with its productive resources not developed, to a population settled and settling not in villages or groups, but in independent and isolated plantations, and more than all, to a radically unrepublican constitution of society, these laws failed to accomplish their beneficent objects. The provisions of the amended Constitution of 1798, reordained in that of 1839, that 'the arts and sciences shall be promoted,' and 'the General Assembly shall provide effectual measures' for elementary as well as higher institutes, did not establish free schools, provide competent teachers, awaken public interest, or keep the legislature informed of the exact state of education in different parts of the State. The national census of 1840, while it showed the existence of 11 colleges (so designated) with 622 students, and 176 academies with 7,878, and only 601 primary schools with 15,561 pupils, for a white population of over 400,000, of whom 30,717 persons (increased to 42,000 in 1850,) over 20 years of age were returned unable to read and write. In 1843, and again in 1854 and 1856, after a personal visit of the writer of this article, and correspondence with prominent citizens, a plan was devised to create a system of common schools, open alike to rich and poor, supported by public tax, State and local, and administered by district, county and State commissioners. The plan met with favor in the legislature both in 1854 and 1856, but failed in spite of the eloquent appeal of Hon. W. H. Stiles, Speaker of the House, 'Let us, by the passage of this bill, inaugurate a system of common schools in Georgia. In the name and in behalf of 150,000 Georgians, between 5 and 20 years of age, who are growing up in ignorance of the duties and relations of civilized life, I demand it. In the name of 42,000 of my countrymen, over the age of 20 years, who are daily hurrying to the grave without being able to read for themselves the way of eternal life, I demand it. In the name and in behalf of the whole State, which we proudly call the 'Empire State of the South,' I demand it. And in what, pray, does her empire consist? In lands and tenements, in fields and stocks, in railroads and copper mines, but not in that which exceeds them all, in cultivated intellect. It is an empire of matter, and not of mind, of darkness and not of light. Enlighten this darkness, efface from her escutcheon that foul blot of illiteracy which the census discloses, or never call her again the Empire State.' The census of 1870 disclosed a progressive increase of illiteracy; the events of the war, having added the entire black race at once to the number of citizens, and the ranks of the illiterate, making 468,593 persons over 10 years of age who could not read.

In 1870 a school system was established, with the following school authorities:

(1,) A State Board of Education, consisting of the Governor and other State officers, acting through a State School Commissioner. To this Board is given the apportionment of any State appropriation, and supervision.

(2,) A County Board of Education, consisting of a member for each militia district. By this Board a County School Commissioner is elected, who thus becomes a member, and its secretary. To this Board belongs the examination of teachers, the inspection of schools, and the imposition of a tax.

(3,) School Trustees for each militia district, which has been made a school district. This Board manages the school, and reports to the County Commissioner.

(4,) The city school authorities of Augusta, Columbia and Savannah, instituted by special acts, by which graded systems of public schools are established for the respective cities and the counties of which they form part.

ILLINOIS.

Illinois became one of the United States Dec. 3, 1818, with a population in 1820 of 55,211, which had increased in 1870 to 1,680,637. By an ordinance dated Aug. 26, 1818, the convention which framed the State Constitution accepted a proposition contained in act of Congress passed April 18, 1818, as a condition precedent of the admission of the people of the Illinois Territory, and to be obligatory upon the United States, viz., 'That section numbered 16 in every township shall be granted to the State for the use of the inhabitants of said township for the use of schools; that five per cent. of the net proceeds of public lands within the State and sold by Congress after the first day of January, 1819, shall be reserved for the following purposes, viz., two-fifths for making roads leading to the State, and the residue shall be appropriated by the Legislature of the State for the encouragement of learning, of which one-sixth part shall be exclusively bestowed on a college or university.' 'That 36 sections, or one entire township, to be designated by the President of the United States, together with the one heretofore reserved for that purpose, shall be reserved for the use of a seminary of learning, and vested in the Legislature of said State to be appropriated solely to the use of such seminary.'

Much legislation has been had on the management of the funds growing out of the lease and sale of the lands thus donated, and the controversy over the possession of portions of the avails of the United States reservations paid over to the State has not ceased. The capital of these funds in 1871 was as follows: School Fund, $613,363; College or University Fund, $156,613; Seminary Fund, $59,839; County School Fund, $348,285; Congressional Township Fund, $4,868,555; Surplus Revenue Fund, $335,592;—*Total*, September 30th, 1872, $6,382,248.

The first general school law was passed in 1825, 'to provide for the establishment of free schools,' with the following preamble: 'To enjoy our rights and liberties we must understand them; their security and protection ought to be the first object of a free people; and it is a well established fact that no nation has ever continued long in the enjoyment of civil and political freedom, which was not both virtuous and enlightened; and believing that the advancement of literature always has been, and ever will be, the means of developing more fully the rights of man; that the mind of every citizen in the republic is the common property of society, and constitutes the basis of its strength and happiness; it is, therefore, considered the peculiar duty of a free government like ours, to encourage and extend the improvement and cultivation of the intellectual energies of the whole.'

The upward and onward movement of common schools in Illinois dates from the legislation of 1854, for which preparation had been made by long and persistent individual and associated labor. Among these should be mentioned the seven founders (particularly Baldwin, Turner, and Sturtevant,) of the Illinois College from 1829; the *Ladies' Association for Educating Females*, founded at Jacksonville in 1833; the *Illinois Institute of Education*, founded at Vandalia in the same year; the *Illinois State Educational Society*, founded at Springfield in 1841; the *Northwestern Educational Society*, begun in 1845; the *Industrial Education Conventions*, from 1851; the *Teachers' Association*, county-wise from 1845, and culminating in the State Associations in 1853; the publications of the *Common School Advocate* in 1837, the *Illinois School Advocate* in 1841, the *Prairie Farmer*, and *Illinois Teacher* in 1853.

In 1854 provision was made for the election by the people of a Superintendent of Public Instruction, to hold his office for two years, and whose whole time should be devoted to the supervision of the common schools, to conferences with teachers and school officers, to public addresses in the different counties, and to the advancement of public education generally. He was specifically required to make a report every year, and in the year following his election, to report to the Legislature by bill 'a system of free school education throughout the State, to be supported by a uniform *ad valorem* tax upon property to be assessed and collected as the state and county revenue is assessed and collected.'

In 1855 a bill for the thorough organization of the common schools was drawn up by the superintendent, the basis of which was the principle of state and local taxation for educational purposes, and a series of school officers for local and general administration to secure uniformity and efficiency in the schools. The bill became a law, and under it were: (1,) A State Superintendent of Public Instruction, elected by the people. (2,) A School Commissioner for each county, elected by the township boards of education in that county. (3,) A Board of Education for each township. Provision was made for County School Conventions and Teachers' Institutes, and an examining committee for each county. No school could receive any portion of the state or local school moneys unless it had been kept for at least six months for the equal and free instruction of all persons. The law has been modified and revised from time to time, and the system of public instruction has been extended by the addition of new institutions until it has reached a high degree of efficiency in the School Law of 1872.

The State now requires and secures official returns from all institutions established, incorporated, or aided to any extent out of public funds, and of the school attendance of all its children and youth, and the causes of the neglect of any person growing up in illiteracy, either white or black. Provision is made to protect the public schools against the employment of incompetent persons as teachers, by providing a Normal University, teachers' institutes, teachers' associations, the advice and co-operation of school officers, and then the thorough examination by experts of all applicants in a range of specified studies as extensive as was ever before inserted in the qualifications of common school teachers, viz., orthography, reading in English, penmanship, arithmetic, English grammar, modern geography, the elements of natural science, the history of the United States, physiology, and the laws of health, which the law declares must be thoroughly and efficiently taught; vocal music and drawing may be insisted on when deemed expedient by the directors. And these studies may be extended at the discretion of the Board of Education in all large cities.

The school authorities are:

(1,) State Superintendent, elected by the people for a term of four years, who is the legal adviser of all school officers and teachers, and who must address the county superintendents by circular on all points touching the system, and the organization, instruction, and discipline of schools, and report annually to the Governor on the condition and improvement of the educational institutions of the State.

(2,) County Superintendent, elected by

the voters of each county to hold office for four years, who must visit at least once in each year every school in his county, and to note the method of instruction, the branches taught, the text-books used, and the discipline, government, and general condition of the schools. He shall give such directions in the science, art, and method of teaching as he may deem expedient and necessary, and shall be the official adviser and constant assistant of the school officers and teachers of his county, and shall faithfully carry out the advice and instructions of the State Superintendent. He shall encourage the formation and assist in the management of county teachers' institutes, and labor in every practicable way to elevate the standard of teaching, and improve the condition of the common schools of his county. In all controversies arising under the school law, his advice shall first be sought, and all appeals to the State Superintendent must be taken up on the statement of facts certified by him. In case of failure of any township officers to provide the authorized information and statistics, he can employ a competent person to examine all books and papers, and obtain and furnish the same.

(3.) Township Trustees for each township (one elected each year for a term of three year), who must secure an efficient school in each legally constituted district, for a period of six months in each year, and a High School for the winter term when so ordered by the town.

(4,) District Directors, one for each district, into which a township may be divided, who must, among other items, report the names of persons over 12 and under 21 residing in the district unable to read and write, and the causes of such neglect. To this office is committed the power of levying a tax on the property of the district to continue the school for not less than 5 or more than 9 months, and to excuse the attendance of children under 12 years for more than four hours each day.

In 1872 there were 11,156 common schools (9 high, 651 graded, and 10,414 ungraded,) with 672,782 pupils under 20,285 teachers (11,459 females), in 10,979 schoolhouses (cost, with ground and apparatus, $18,373,880); 58 academies and colleges; 20 professional and special schools, 4 teaching, 2 law, 2 medicine, 2 agriculture, 1 blind, 1 deaf mute, 2 commercial, 1 art, and 700 private schools.

### INDIANA.

Indiana was organized as a Territory in 1800, and admittted as a State in 1816, with a population in 1820 of 145,750, which in 1870 had increased to 1,680,637, with a valuation for taxable purposes of $663,-455,044.

The history of education in Indiana commences with the Act of Congress of 1804 providing for the sale of the public lands, which directed that the Secretary of the Treasury should select a township of land in several portions of the northwestern territory for the use of seminaries of learning, and that the section numbered sixteen in each and every township should be reserved for the use of schools. No application of these lands was, however, made until 1816, when Congress passed an ordinance to enable the people of the Indiana Territory to form a constitution and be admitted into the Union. That ordinance provided that one township of land, in addition to the one heretofore reserved, should be granted to the State of Indiana for the use of a seminary of learning, and that the sixteenth section in every township, and where that had been otherwise disposed of, other lands in lieu thereof should be granted for the use of schools. The proposition was accepted, and after the admission of the State of Indiana into the Union, a State University was established at Bloomington in Monroe county, and the proceeds of the sales of the two townships were directed to be funded, and the income thereof annually applied to the support of the institution.

The constitution of 1816 makes it the duty of the General Assembly 'to provide by law for a general system of education, ascending in regular gradation from township schools to a State University, where tuition shall be gratis and equally open to all.' This duty is reaffirmed in the constitution of 1851, with provision for the election of a superintendent, and a consolidation and enlargement of the Common School Fund, which is declared to consist of:

(1,) Congressional Township Fund and land; (2,) United States Surplus Revenue Fund; (3,) Saline Fund and land belonging thereto; (4,) Bank Tax Fund; (5,) County Seminaries' Fund, and fines assessed for breaches of the penal laws; (6,) Swamp Land Funds.

The aggregate of these funds in 1870 amounted to $7,282,639, and the income from the same to about $400,000, which was increased by property and capitation tax to the sum of $1,810,866.

The first school law was enacted in 1821, which underwent many revisions and modifications, without producing efficient schools, and leaving Indiana in 1840 behind most of the other States, and in 1840, according to the national census (out of a population of 988,416), there were 70,540 persons over 20 years of age who could not read or write, of whom less than 1,000 were returned as native born. Under the energetic appeals of 'One of the People' (*Prof. Caleb Mills of Wabash College*,) addressed from year to year, from 1840 to 1848, to the people of Indiana, as a sort of supplement to the Governor's message, the Legislature was finally aroused to efficient action, and in 1848 an act to provide a system of free schools was passed. It having been left with the counties to repeal or adopt its provisions by popular vote for its respective townships, many counties adhered to the old defective system, but the Constitution of 1850, and the school law of 1855, brought up the legal requirements to a higher and a uniform state, and from that time the schools have been under agencies which have constantly improved the quality of the instruction given, although they have not prevented an alarming amount of illiteracy, viz., 76,634 persons over 10 years of age who could not read, and 187,124 who could not write, according to the census of 1870.

The system is now administered by: (1,) State Superintendent; (2,) State Board of Education, composed of State Superintendent, president of State University and State Normal School, and the superintendents of the three largest cities; (3,) County Commissioners, one for each of the 92 counties, who visit the schools of their respective townships, hold institutes, and appoint; (4,) District Superintendents, who hold office for three years, and examine all candidates for teaching; Township Trustees, who may, among other powers, introduce the study of the German language into any school where the parents or guardians of 25 children demand it.

In 1870, out of 619,627 children between the ages of 5 and 21, 462,527 attended in the 8,759 district and high schools (including 34 cities), taught by 11,846 teachers (4,722 females), and maintained at a cost of $1,810,866.

IOWA.

Iowa was organized as a territory in 1838 and admitted into the Union in 1846, with an area of 55,045 sq. m., and a population in 1850 of 192,214, which has increased to 1,191,792 in 1870, with taxable property valued at $302,515,418. The constitution of 1846 provides for the inviolability of the school and university funds, and the election by the people of a superintendent of public instruction, to hold his office for three years, directs the General Assembly to encourage intellectual, scientific, moral and agricultural improvements, and provide a system of common schools, by which a school shall be kept up and supported in each school district at least three months in every year. The amended constitution of 1857 goes into much detail, respecting the powers of a 'Board of Education for the State of Iowa,' to which was given 'full power to legislate and make all needful rules and regulations in relation to common schools, and other educational institutions aided from the school or university funds, subject to the revision and repeal of the General Assembly.' Power was reserved to the General Assembly to abolish or reorganize the Board of Education at any time after 1863, and provide for the educational interests of the State in such manner as shall seem to them best and proper. The action of the Board, instituted according to the provisions of this constitution, did not prove acceptable to the people, and in 1864 the school system as established by them was reorganized by the General Assembly.

By the act of 1863 and its subsequent amendments the school authorities are: (1,) State Superintendent, elected by the people for two years; (2,) County Superintendents, one for each county, elected for two years; (3,) Township Board of Directors, made up of three or more sub-directors for each township, who have the management of the township school fund; and (4,) Sub-director for each sub-district, for the local management of the school.

According to the report of 1871, there were 1,260 district townships, 344 independent districts (cities and villages), and 7,716 sub-districts, with 7,823 schools, of which 289 are graded, in which are 40 high schools; out of 460,629 school population (between 5 and 21 years) 341,938 attended school during the year, under 14,070 different teachers, at an aggregate salary of

$1,900,893, in 7,594 school-houses, erected at a cost of $6,764,551, in which was school apparatus to the value of $104,359. In 1871, 7,500 teachers met in 76 teachers' institutes. There are two School Journals and a State Teachers' Association.

According to the national census in 1870 there were 217,554 persons of all ages in 7,496 schools, of which there were 1 normal, 37 high, 41 grammar, 294 graded, and 6,949 ungraded common schools; 1 university, with 23 professors, and 403 pupils; 21 classical colleges, and 34 academies, and 5,200 pupils; 1 school of law, 1 of medicine, and 4 of theology, with 209 pupils; 10 special schools, with 850 pupils; (1 agricultural, 5 commercial, 1 blind, 1 deaf mutes, 2 music); 103 private schools, with 5,300 pupils; and 24,115 persons over 10 could not read, and 45,671 (24,979 natives) could not write.

The school fund amounts to $3,174,578.

KANSAS.

Kansas organized as a Territory in 1854, was after many tribulations, admitted as a State in 1859, with an area of 91,318 sq. m., and a population in 1860 of 107,206, which had increased in 1870 to 364,399, and a taxable property of $92,125,861. Total value of farms and live stock in 1870 was $126,992,538.

The constitution adopted in 1858, provides for a superintendent of public instruction for the State, and one for each county, and directs the legislature to 'encourage the promotion of intellectual, moral, scientific and agricultural improvement by establishing a uniform system of common schools, and schools of higher grade, embracing normal, preparatory, collegiate and university departments.' 'The proceeds of lands donated by the United States or the State for the support of schools, and the 500,000 acres granted to the new State in 1841, and all estates of persons dying without heirs or will, and such per cent. as may be granted by Congress on the sale of lands in this State are made a perpetual school fund, which shall not be diminished, the interest of which with such other means as the legislature may furnish by tax or otherwise, shall be inviolably appropriated to the support of common schools.' 'Provision shall be made by law for a State University for the promotion of literature and the arts and sciences, including a normal and agricultural department,' and 'no religious sect or sects shall ever control any part of the common school or university funds of the State.'

Schools are organized on the basis of cities (incorporated by general law), and of the congressional township distribution of territory. Each city by general law has a board of education somewhat differently constituted, but all with full powers to establish and maintain public schools according to its population, while each congressional township, embracing an area of six miles square, is constituted one school district. Each district is divided into sub-districts of any convenient size, by the county superintendent. Each sub-district elects a director, and all the directors of sub-districts constitute a school district board for the township, with power to levy taxes, locate, and erect school-houses, employ teachers for the schools of the township, and with power to erect a higher school for the older children of all the sub-districts.

The school authorities are: (1,) State Superintendent, elected for two years, with the usual powers; (2,) County Superintendents, one for each county, elected for two years, with power to divide the congressional townships into districts, examine (when associated with two competent persons appointed by the County Commissioners, who together constitute a County Board of Examiners,) teachers, hold institutes, and generally administer the system for the county; (3,) Township Boards, composed of a director from each sub-district into which the township district is divided; (4,) District Boards, composed of the director, clerk, and treasurer; (5,) City Boards of Education, charged with full powers of local management of public schools in the several incorporated cities.

According to the report of the superintendent for 1872 there were 3,419 sub-districts, containing 165,982 persons between the ages of 5 and 21 years. Of this number 106,663 were enrolled in the public schools, with an average daily attendance of 61,538 pupils under 3,835 different teachers (2,048 females), to whom was paid for their services $596,611, The entire expenditure on account of public schools in 1871 was $1,701,950, of which $217,810 was received from the State (interest from the permanent fund and taxes), $22,680 from county funds, $822,644 from district tax, and $431,382 from tuition and other sources. The total number of school-houses for 3,419 organized districts was 2,437, valued, with lots and apparatus, at $2,845,262. Beside the public schools there are two State Normal Schools (at Emporia and Leavenworth), with buildings erected at a cost of $140,000, and an average attendance in both of 300 pupils.

Out of section 16, and 36 in each township, and the 500,000 acres (total nearly 3,000,000 acres), only $759,095 has yet been converted into a permanent school fund. The university received 46,000 acres, out of which only $10,000 has yet been realized as a permanent fund. The grounds and improvements have cost $164,000, mainly contributed by the city of Lawrence. The Agricultural College receives $90,000 from Congressional grants, out of which $189,745 have been realized, leaving land unsold estimated at $180,797, or a total of $378,542. The State University was crippled at the start by the incorporation of two denominational institutions of higher education (Baker University and Washburne College), on which $200,000 have already been expended for buildings and equipments.

The census of 1870 returns a school attendance of 63,183, out of a school population (between the ages of 5 and 18) of 108,710, with 16,369 persons 10 years of age who could not read, and 24,550 who could not write. In the table of schools there were 1,663 public schools (1 normal, 4 high, 1 grammar, 118 graded, 1,539 ungraded), with 1,955 teachers; 2 universities with 13 teachers (1 female), and 292 students; 5 special schools (1 agricultural, 2 commercial, 1 blind, 1 deaf mutes), with 277 pupils; and 11 private schools, with 671 pupils.

### KENTUCKY.

Kentucky was settled from Virginia, of which it was part until 1791, when it was admitted as a State, with a population of 73,077, which in 1870 had increased to 1,321,011. In its educational and economical policy it followed the mother State—relying on colleges, academies and private tutors for families who could pay, and making no general provision for common schools until 1821, when a Literary Fund was established out of one-half of the clear profits of the Bank of the Commonwealth. This law was made slightly efficient by the act of 1830, 'to establish a uniform system of public schools,' in which this provision occurs. 'any widow or *femme sole* over 21 years of age, residing and owning property subject to taxation for school purposes in any school district, shall have the right to vote, either in person or by written proxy; also infants so situated may vote by proxy.' In 1838 an act to establish a system of common schools was passed, by which a Board of Education was instituted, of which the Superintendent of Public Instruction, appointed by the Governor with the consent of the senate, was made a member and the executive officer. By this law the State was divided into districts, and the income of the small permanent fund was increased by a tax of two cents (made three by popular vote in 1850) on every one hundred dollars of taxable property in the State, designed, according to a subsequent act (1845), 'to encourage and aid the citizens to organize and maintain common schools.' In 1842 the Superintendent was instructed to report on creating the profession of teaching, and in 1854 the legislature made provision for the education of 150 teachers in the State University at Lexington. But the difficulties of a sparse population, and the peculiar social and industrial habits of the people render a system of common schools impossible, and the schools never got such a lodgment as to materially modify the habits of the State except in Louisville, where the graded system was truly efficient, its public high school, teachers, and superintendence comparing favorably with these features in any city. The census of 1870, out of a school population (5 to 18) of 454,539, returns 181,225 persons in attendance in the year previous, and out of the entire population (1,324,011), 249,567 persons over 10 years who can not read, and 321,176 who can not write.

According to the same census there were in 1870, 5,149 schools of all kinds in operation; 4,727 public schools, viz., 1 normal, 23 high, 19 grammar, 88 graded, 1,596 ungraded, with an aggregate of 218,440 pupils; 137 classical academies and colleges (including two universities), with 12,088 pupils; 15 professional and special schools, 2 law, 4 medicine, 5 theology, 1 agricultural, 8 commercial, 1 blind, 1 deaf mutes, 1 idiotic.

According to the report of the State Superintendent for the year ending June 30, 1871, there were 5,117 school districts, in which 5,068 schools were taught to 120,866 pupils, at an expense to the State (about $156,000 income of school funds, $802,000 avails of State property tax,) of $968,176, to which will be added next year the avails of "a rate bill assessed on each patron of the school, according to the number of children and length of time actually sent by each." The State tax is about 2 mills on each dollar of taxable property, which, according to the census in 1870, was $469,544,294.

### LOUISIANA.

Louisiana was admitted a State in 1812, with a population in 1810 of 76,556, which had increased to 726,915 in 1870. While in a territorial organization, the University of Orleans was instituted, and provision was made for a college in the city of New Orleans, and at least one academy and one public library in each county, and for the support of the same, $50,000 was to be raised annually. In 1808 authority was given to institute elementary schools in each parish, which in 1819 were placed under police juries, and in 1821 under five trustees appointed by the police jury of each parish, from the resident landowners; and the sum of $800 was appropriated annually to each parish for such schools, which could be increased by a local tax on the property of the parish. In 1833 the Secretary of State was made Superintendent of Public Education, and required to submit to the Legislature annually a report on the condition of schools, academies, and colleges. In 1849 special authority was given to the Second Municipality of New Orleans to establish a system of public schools supported by a tax on the property, which system was organized in that year on a plan submitted by Henry Barnard of Connecticut, to whom the position of superintendent was tendered before the schools were opened, and again in 1849. In the constitution of 1845, it is ordained that a superintendent of public education shall be appointed, and that free public schools shall be established throughout the State supported by taxation on property, and that all lands donated by the United States shall constitute a perpetual fund, on which the State shall pay an annual interest of six per centum for the support of such public schools. In 1847 an act 'to establish Free Public Schools' for all white children between the ages of 6 and 16, provided for the appointment of a State Superintendent, and of a superintendent for each parish, and the collection of a tax of one mill on the dollar of the taxable property of the State, and establishment of a State School Fund out of a consolidation of all land grants (786,044 acres for common schools,) and individual donations made for educational purposes. To these revenues was added in 1855 a capitation tax of one dollar on each free white male inhabitant over the age of twenty-one years. The almost insuperable difficulties of a sparse population, divided socially by race and occupation, made a system of common schools almost impossible out of New Orleans, and Baton Rouge, and the larger villages.

In the constitution of 1868 it is ordained that 'the General Assembly shall establish at least one free school in each parish, and provide for its support by taxation or otherwise.' 'All children between the years of 6 and 21 shall be admitted to the public schools or other institutions of learning sustained or established by the State in common, without distinction of race, color, or previous condition. There shall be no separate school or institution of learning established exclusively for any race by the State of Louisiana.' Provision is made for the election by the qualified voters of the State of a Superintendent of Education, to hold his office for four years, and to receive a salary of $5,000 per annum. In the spirit of these provisions, a system of public schools was inaugurated in 1870, which with abundant means, has encountered almost insuperable obstacles from the prejudices of race and the disturbed condition of the public mind. 'Colored citizens are willing to receive the benefits of the schools, but have not the knowledge or experience required to establish and manage a system; the white citizens are opposed to mixed schools.'

The school authorities are: (1,) a State Superintendent; (2,) State Board of Education, composed of the State and six Division Superintendents; (3,) a Superintendent for each Judicial District, of which there are six; (4,) Parish Directors, composed of one member for each jury board; (5,) Town and City Boards. The means of support consist of (1,) Free School Fund, $1,193.500; (2,) Seminary Fund, $138,000; (3,) Amount levied on property, $468,035; amount of poll tax, $112,668. The State tax is two mills on the dollar upon all taxable property.

The census of 1870 returns a school attendance of 51,259, out of a population (persons from 5 to 18 years) of 226,114; and 592 schools of all kinds, viz., 178 public, (1 normal, 5 high, 4 grammar, 60 graded common, and 108 ungraded common), with a total of 25,088 pupils; 36 classical academies and colleges (including 2 universities), with 4,357 pupils; 10 professional and special schools, viz., 1 law, 1 medicine, 1 theology, 1 blind, 1 deaf mutes, and 4 commercial.

### MAINE.

Maine was settled under the colonial jurisdiction of Massachusetts, and acted under the school legislation of that commonwealth, until 1820, when it was admitted as a State, with a population of 298,335, which had increased in 1870 to 626,915. The constitution of 1820 makes it the duty of the legislature 'to require the several towns to make suitable provision at their own expense, for the support of public schools, and to encourage and suitably endow academies, colleges and seminaries of learning within the State; *provided*, that no donation, grant, or endowment shall at any time be made by the legislature to any literary institution, unless at the time of making such endowment the legislature shall have the right to grant any further powers to alter, limit, or restrain any of the powers vested in any such literary institution as shall be judged necessary to promote the best interests thereof.' The first school law distinct from that of Massachusetts was passed in 1821, by which each town was required to raise by tax on the polls and estates of the citizens a sum of money, which in the aggregate would amount to at least 40 cents for each inhabitant. This sum, increasing from year to year with the population was apportioned among the several school districts into which each town was divided, for the support of public schools, equally free and accessible to all the children between the ages of 4 and 21 years, under the local care of an agent appointed by the town for each district, and the general supervision of a superintending committee for the whole town in the matter of teachers and studies. These fundamental principles were slightly altered in 1822 and 1825, by which the election of the agent was left, on the vote of the town, to the district, and the towns of Portland in 1825, Bath in 1828, Bangor in 1832, and all other towns in 1834, were allowed to dispense with a district agent and put all their schools under one board. In 1825, the selectmen of the several towns were required to make returns to the Secretary of State, once in three years, as to the number of districts, the number of scholars of school age, and the number in actual school attendance, the length of time the schools were kept, and the amount expended in each. Maine was thus the second State to require such returns, and which became henceforth the basis of all school discussion. In 1828 a permanent State School Fund was commenced by setting apart the sales of twenty townships of the State lands for that purpose;* and the principle of a graded school by the employment of a master and teachers in the same district was recognized. —After much discussion in local and State conventions, and in the legislature from 1838 to 1846, in the year last named a State Board of Education was instituted, and in 1847 the mistress was required to keep a register, and return the same at the close of the school to the town school committee, who were required henceforth to make the statistical return to the Board of Education. In 1835 the first educational association was formed, and in 1838 the State Teachers' Association was organized. In 1846 the first Teachers' Institute was held; in 1863 a State Normal School was opened at Farmington, and a second at Castine in 1865; and in 1869 the office of County Supervisors was established, and $16,000 appropriated for their salaries.

According to the revision of 1871, the administration and supervision of common schools is committed to: (1,) State Superintendent, appointed by the Governor and council for three years, or during the pleasure of the executive, to exercise general supervision, advise and direct town committees, obtain and disseminate information respecting the schools of the State and other States and countries, awaken and sustain a popular interest in school matters, hold annually a State educational convention, and an institute of teachers in each county, prescribe the studies that shall be taught (reserving to town committees the right to pre-

* In 1784 the legislature of Massachusetts directed the committee charged with the sale of eastern lands to reserve, in each township conveyed, 200 acres for the use of the ministry, 280 for the first settled minister, 280 for the grammar school and 200 for the future appropriation of the General Court. This resolve was modified in 1785 so as to require a reservation of five lots of 320 acres each, in every township six miles square, one for each of the purposes above specified. This resolve in the articles of separation in 1818, became applicable to all grants and sales of land made by Massachusetts or Maine. The present practice in Maine is to reserve in each township 1,000 acres for the use of schools, which, after the township is settled, form a school fund for the town. Down to 1834 more than half a million acres of land had been donated by the State to incorporated academies, and nine townships of land to two colleges.

scribe additional studies), act as superintendent of the State Normal School, and report annually to the legislature. (2,) County Supervisors, appointed by the Governor, on the recommendation of State Superintendent, for each county, for three years, an assistant of the State Superintendent, and together with him constituting a State Board, to meet at least once a year during the session of the legislature for the purpose of conferring with the educational committee of that body, and maturing plans for the following year to promote and elevate the public schools. (3,) Town Superintending School Committee, of three members, elected one each year for a term of three years, who examine, after public notice of time and place, all candidates for teaching in reading, spelling, writing, English grammar, geography, history, arithmetic, and other studies usually taught in public schools, and particularly in the school for which he is examined, and also his capacity for the government thereof; and employ teachers for the several districts, prescribe regulations for the studies, books, discipline, and returns of all the public schools. (4,) District Agents, one for each, where the town is divided into districts.

The support of public schools is derived from (1,) State School Fund, the income of which, and all money received by the State from the tax on banks, together 'with a mill tax for the support of common schools, assessed and collected as other State taxes, and paid out according to the number of scholars in each;' (2,) Town Tax, not less than one dollar for each inhabitant, exclusive of the income of corporate school funds, or revenue from the State, or devise, bequest or forfeiture to the use of schools; (3,) District Tax, for site, construction, and equipment of school-houses, and for maintaining graded schools, not exceeding the sum received from the town.

In 1870 the total cost of 4,000 common schools was $1,077,927, to which the towns voted by tax $740,321, and the school fund ($293,596) $12,409; districts to continue schools, $24,000; balance by the State.

According to the census of 1870 the whole number of schools of all kinds was 4,723, with 6,986 teachers (2,320 males, 4,556 females), and 162,636 pupils, out of a school population (5 to 18 years) of 175,488; 13,486 persons over 10 years of age could not read, and 19,052 could not write.

MARYLAND.

Maryland was first settled in 1634, had in 1790 a total population of 319,728, which had increased in 1870 to 780,894, on an area of 11,124 sq. m., and with $423,834,919 of taxable property. The Constitutions of 1776 and 1851 had no provision respecting education; that of 1864 prescribed even the details of organization and the amount of taxation ('not less than ten cents on each hundred dollars of taxable property, until the existing School Fund has been increased to $6,000,000 by the accumulating avails of an annual tax of five cents on the taxable property, when the annual State tax for school purposes shall be reduced to five cents'). These provisions in the revision of 1868 gave way to three brief articles, by which it is made the duty of the first General Assembly 'to establish by law a thorough and efficient system of free public schools, and to provide by taxation or otherwise for its support,' and to continue the system of public schools established by and under the Constitution of 1864, until the end of the first session of the General Assembly held after 1868.

In 1671 an act passed the upper house of the assembly 'to found and erect a school or college in the province of Maryland, for the education of youth in learning and virtue,' which in the lower house was returned with a message asking that the place for the college might be named, and 'that the schoolmasters of such school or college should be qualified according to the Reformed Church of England, or that there be two schoolmasters, one for the Catholic and one for the Protestant children, and the Protestants shall have leave to choose their schoolmaster;' and 'the Lord Proprietor be pleased to set out his declaration as to what privileges and immunities shall be enjoyed by scholars brought up or taught at such schools.'

In 1694, and again in 1696, a 'petitionary act for free schools' was addressed to his Most Excellent Majesty asking 'for His Majesty's princely royal benediction and aid in the establishment of schools and colleges of universal study; and for the propagation of the gospel and education of youth within the province in good manners and letters,' especially for 'free school or schools or places for the study of Latin, Greek, writing, and the like,' with 'one master, one usher, and one writing master or scribe to a school of one hundred scholars, more or less, according to the ability of said free school,' and that 'the Most Reverend Father in God, Thomas, by the grace of God, Archbishop of Canterbury, and Metropolitan of all England, may be chancellor, and to perpetuate the memory of your Majesty, the first, at Anne Arundel town, be called King Williams school or college, and be managed by certain trustees nominated and appointed by your Sacred Majesty,' and so on 'until each county of the province shall have one free school, and apply so much of the revenues to each school as they shall deem most expedient, not exceeding 120 pounds per annum.' Under this and subsequent acts in 1715, 1717, 1723, and especially of the last, a 'free school,' inadequately endowed, was established in each county, 'the trustees were to have perpetual succession, the schoolmasters were to be members of the Church of England, of pious, exemplary lives, and capable of teaching well, grammar, good writing, and mathematics; for which they were to be allowed the use of the 100 acres of land attached to the school, and £20 per annum, paid out of the county allowance.'

From an advertisement in the Gazette, February, 1774, it would appear that families were supplied with private teachers after a peculiar fashion. 'To be sold, a schoolmaster, an indented servant that has got two years to serve.' John Hammond, near Annapolis. N. B. 'He is sold for no fault, any more than we are done with him. He can learn book-keeping, and is an excellent scholar.'

The Revolution freed nearly all the clergymen of the English Church, who had attached themselves to the side of the mother country, from their clerical services, and most of them eked out a precarious support for many years by receiving pupils into their families, and setting up private schools.

The earliest law for general education was the act of 1825, 'to provide for the public instruction of youth in primary schools,' by which a State Superintendent was appointed to digest and report a system; and County Commissioners, to divide up the counties into school districts, for which three trustees were to be elected by the qualified voters; and Inspectors for the visitation of the schools and examination of teachers. Two reports were made by the superintendent, which were occupied with the details of the monitorial system and the plan of a central school for teachers, which at that date was attracting much attention, and had been officially noticed and commended by Gov. Clinton to the legislature of New York. The office was abolished in 1827, and not revived till 1865, in pursuance of a provision of the constitution of the year previous.

The avails of the school fund continued to be distributed through the County Commissioners, and the capital was increased by the amount of the U. S. Surplus Revenue Fund. The great result of the movement of 1825 was the permanent establishment of public schools in the city of Baltimore, which in 1870 included 102 day schools (1 college for boys, 2 high schools for girls, 37 grammar, 60 primary, and 2 unclassified schools), with 21,795 pupils, under 511 teachers, besides 6 evening schools, and 13 schools for colored children—a total of 121 schools, 571 teachers. and 24,673 scholars.

The act 'to establish a uniform system of public instruction' of 1865, vested its supervision and control in a State Board of Education, and in a board of school commissioners for the city of Baltimore and each county, embraced a series of schools from the neighborhood or primary, and township grammar, to a county high school and a State normal school, and directed that 'every child in the State between the ages of 8 and 14 years, without fixed employment, shall attend school at least six months in each year, and that no child under the age of 14 years shall be employed in any business, unless such child has attended some school six months of the year preceding.'

In 1868 the impulse which had been given to school agencies was arrested, and a reaction, both in legislative and administrative activity, followed from which the State has not yet recovered. Under the judicious management of the superintendent (Prof. Newell, principal of the State Normal School), further reaction has ceased.

By the census of 1870, out of a school population of 244,454, there was a school attendance of 105,435, and 114,100 persons over 10 years of age who could not read, and 135,499 who could not write. Of the whole number of schools (1,779) returned, there were: 1,487 public (3 normal, 10 high, 49 grammar, 159 graded, and 1,266 ungraded); 53 classical academies and colleges, including two universities; 19 professional and special schools (1 law, 2 medicine, 4 theology, 1 agricultural, 3 commercial, 1 blind, 1 deaf mutes, 6 art and music); and 220 private schools.

### MASSACHUSETTS.

Massachusetts had by the first national census in 1790, a population of 378,717, which had increased in 1870 to 1,450,350, on an area of 7,800 square miles, with taxable property to the valuation of $1,417,-127,376—second only to the Empire State in this particular.

Massachusetts in its constitution of 1780, was the earliest State to throw the protection of a fundamental ordinance around funds appropriated to educational purposes, and partic larly of Harvard College, 'in which many persons of great eminence have, by the blessing of God, been initiated into those arts and sciences which qualified them for public employment both in church and State; and whereas the encouragement of the arts and sciences, and all good literature, tends to the honor of God, the advantage of the christian religion, and the great benefit of this and the other United States of America,' it is declared that all powers, rights, privileges, immunities, and facilities shall be continued, and all gifts, legacies, &c., are confirmed; and then follows a section drawn up by John Adams, and adopted by the convention unanimously.

Wisdom and knowledge, as well as virtue, diffused generally among the body of the people, being necessary for the preservation of their rights and liberties, and as these depend on spreading the opportunities and advantages of education in various parts of the country, and among the different orders of the people, it shall be the duty of the legislatures and magistrates, in all future periods of this commonwealth, to cherish the interest of literature and the sciences and all seminaries of them, especially the university at Cambridge, public schools, and grammar schools in the towns; to encourage private societies and public institutions, by rewards and immunities for the promotion of agriculture, art, sciences, commerce, trades, manufactures, and a natural history of the country; to countenance and inculcate the principles of humanity and general benevolence, public and private charity, industry and frugality, honesty and punctuality in all their dealings; sincerity, good humor, and all social affections and generous sentiments among the people.

Among the articles of amendments ratified by the people in 1857, are the following: 'No person shall have the right to vote, or be eligible to office under the constitution of this commonwealth, who shall not be able to read the constitution in the English language and write his name,' unless prevented by physical disability from complying with the requirement, and unless he already enjoys the right to vote. 'All moneys raised by taxation in town and cities for the support of public schools, and all moneys appropriated by the State for the support of common schools' 'shall never be appropriated to any religious sect for the maintenance exclusively of its own schools.'

The earliest legislation of Massachusetts respecting schools, and 'the good education of children,' bears date 1642, which, with various modifications as to details, kept the following objects steadily in view, viz.: the exclusion of 'barbarism' from any family, by making it the duty of the selectmen of every town, in the several precincts and quarters where they dwell, to have a vigilant eye over their brethren and neighbors,' 'to see that they teach their children and apprentices by themselves and others so much learning as may enable them to read the English tongue, and the capital laws, upon penalty of twenty shillings for each neglect therein,' 'to learn some short orthodox catechism without book,' and 'to breed and bring them up in some honest lawful calling, labor, or employment, either in husbandry, or some other trade profitable for themselves and the commonwealth, if they will not, or can not train them up in learning to fit them for higher employments;' and, should parents 'continue negligent of their duty in the particulars above mentioned, whereby children and servants become rude, stubborn and unruly, the selectmen, with the help of two magistrates, shall take such children or apprentices from them, and place them with some masters for years, boys till they come to twenty-one, and girls to eighteen years of age complete, who will more strictly look into and force them to submit unto government, according to the rules of this order, if by fair means and former instruction they will not be drawn into it.' To enable parents to have places where their children and apprentices may be sent to be taught, it was enacted the same year (1642) 'that every township within this jurisdiction of fifty householders, shall appoint one within their town to teach all such children as shall resort to him, to write and read, *whose wages shall be paid either by the parents or masters of such children*, or by the inhabitants in general, by way of supply, as the major part of those who order the prudentials of the town shall appoint; provided those who send their children be


INTERIOR VIEW OF A SCHOOL-HOUSE IN 1770.


INTERIOR VIEW OF A SCHOOL-HOUSE IN 1870.

CONTRABAND SCHOOLS.

not oppressed by paying much more than they can have them taught in other towns.' In addition to this elementary school, every town of one hundred families, 'shall set up a grammar school, the masters thereof being able to instruct youths so far as they may be fitted for the university,' and the towns which neglect to set up such school any one year, must pay five pounds per annum to the next nearest school. In Plymouth Colony, the provision for schools was not so early, and the requirements for a grammar school were extended in 1677 to towns of fifty families, and impose on 'those who have the more immediate benefit thereof by their children's good and general good, shall make up the residue (over the twelve pounds in current merchantable pay to be raised on all the inhabitants of such town) necessary to maintain the same,' and every town of seventy families which neglected to maintain a grammar schools shall 'allow unto the next town which does, the sum of five pounds collectable by constable on the warrant of any magistrate in this jurisdiction.'

On this basis of the duty of parents to give their children at least an elementary education, and of every town, large or small, to provide the place and teacher where their children could be taught; and of every large town to maintain a teacher competent to fit the same for the university; and of the State to encourage such university, 'that learning might not be buried in the graves of the fathers,' and that some of their sons might be fitted every year for higher employment in church and state, the system of public instruction in Massachusetts has been built up and extended to meet the wants of successive generations. The town grammar school feature, occasionally suspended in some towns, and superseded by the academy and private school in others, has kept the common school up to the requirements of the rich and the educated, and saved the district schools from becoming common in the worse sense, or being regarded as the schools exclusively of the poor, or of those only who knew what constituted the conditions of a good education in respect to house, studies and teachers, but of all, rich and poor, the more or the less intelligent, in the city as well as in the country.

The first revision of the school laws after the revolution was in 1789, by which it is provided 'that towns of fifty families are required to sustain schools wherein children are taught to read and write, and instructed in the English language, arithmetic, orthography, and decent behavior, for a term equal to one school of six months in each year; every town of one hundred families, twelve months; every town of one hundred and fifty families, eighteen months; and every town of two hundred families, twelve months, and in addition thereto sustain a school wherein is taught the Latin, Greek, and English languages for twelve months in each year.' It is also 'made the duty of the president, professors and tutors of the University at Cambridge, preceptors and teachers of academies, and all other instructors of youth, to take diligent care, and to exert their best endeavors to impress on the minds of children and youth committed to their care and instruction, the principles of piety, justice and a sacred regard to truth, love to their country, humanity and universal benevolence, sobriety, industry and frugality, chastity, moderation and temperance, and those other virtues which are the ornament of human society, and the basis upon which the republican constitution is structured; and it shall be the duty of such instructors to endeavor to lead those under their care into a particular understanding of the tendency of the before-mentioned virtues to preserve and perfect a republican constitution, and to secure the blessings of liberty as well as to promote their future happiness, and the tendency of the opposite vices to slavery and ruin.'

By the act of 1789, 'in consequence of the dispersed situation of the inhabitants of several towns,' the children and youth can not be collected in any one place for their instruction,' such towns were authorized 'in town meeting called for that purpose to determine and define the limits of school districts.' In this provision and the supplementary law of 1800 authorizing district taxation for school-houses, originated the district system, which Mr. Mann pronounced the most 'disastrous feature' of the school legislation of Massachusetts; and from the deteriorating influence of which the State has only quite recently escaped into a graded system for the whole town. The act of 1789 excludes from the town grammar school all children 'who have not in some other way learned to read the English language by spelling the same,' and admits as teachers only those who are university graduates, or have a certificate of qualification from a learned minister of the town, and give satisfactory evidence of good moral character.' 'Ministers and selectmen are required to see that the youth regularly attend the school, and once at least, every six months, visit and inspect the schools, inquire into the regulations and discipline thereof, and the proficiency of the scholars therein.' 'That the greatest attention may be given to children in the early stages of life, to the establishing of just principles in their tender minds,' and right habits of reading; 'no person shall keep school without a proper certificate from the selectmen, or a committee duly appointed by each town or district, and the minister, if there be one in the place, on the forfeiture of twenty shillings to the informer and the poor of the place.' Whether under master or mistress, 'a sense of piety and virtue, and decent behavior,' as well as reading, and writing if contracted for, were made the staple of primary instruction.

In 1825 the legislature appointed commissioners 'to digest and prepare a system for the establishment of one or more institutions for instruction in the practical arts and sciences for that class of persons who do not desire, or are unable to obtain, a collegiate education.' This proposition grew out of the discussions which followed the establishment of Mechanics' Institutes in England, Fellenberg's Schools at Hofwyl, and the Rensellaer School at Troy—and the want, long and widely felt, of some essential modification of the studies of the academies and colleges of the country. The report of the commissioners in 1826, and the supplementary report of 1827, anticipates by a quarter of a century the whole movement for the 'new education,' 'the agricultural and mechanical art colleges,' and 'the scientific schools.'

In 1826 towns were authorized to choose a school committee to superintend the schools, to visit and inspect the town and district schools, to examine and approve teachers, to determine class books, and provide the same for such whose parents may be unable to pay for the same; and for the first time to make returns thereafter each year to the Secretary of State (whose duty it is made to furnish appropriate blanks) of the number, state, and cost of each school.

In 1827 a select committee of the House, to whom was referred a memorial of James G. Carter, praying for aid to enable him to establish a 'Seminary for the instruction of School Teachers,' reported favorably; but the bill not becoming a law by the want of one vote in the Senate, Mr. Carter established such a seminary in Lancaster, as a private enterprise, in the same year; and in 1830 a similar seminary was established at Andover, with the expectation that Mr. Gallaudet, of Hartford, would become its principal, but was opened under the direction of Rev. S. S. Hall, who had been a teacher of teachers in a private seminary in Concord, Vermont, from 1822, and whose lectures read to his pupil-teachers were published in 1829, under the title of '*Lectures on School-Keeping*,' almost the first contribution to this department of American literature.

In 1827 the school laws were thoroughly revised, by which, among other modifications, 'in each town of fifty families the teacher or teachers must be employed, must be of good morals, and competent to instruct children in orthography, reading, writing, English grammar, geography, arithmetic, and good behavior, for at least six months in the year;' and in towns of one hundred families, the following branches must be added, history of the United States, book-keeping by single entry, geometry, surveying, and algebra; and in every city or town of four thousand inhabitants the master shall be able to teach, in addition, the Latin and Greek languages, history, rhetoric, and logic.' All towns are authorized to raise by tax any amount of money they may think necessary for the support of schools. Each town may, in addition to the school committee, appoint one person for each district in the town, a resident of the district, to be called a prudential committee, or they may authorize the districts to choose their own committee. The committee are forbidden to prescribe books favoring any particular religious sect.

In 1829 the first public effort to educate the blind was made in Boston, by the incorporation of the New England Asylum for the Blind, and turning over to its use any unexpended balance of the State's appropriation for deaf mutes.

In 1830 the American Institute of Instruction was formed at Boston, composed of members from all parts of the country, and incorporated by the legislature of Massachusetts in 1831, and in 1835, through the influence of James G. Carter, (who more than any other one man was the mover in all the advanced legislation of the State from 1830 to 1838), was aided by an annual grant of $350 to meet the expense of the publication of the annual volumes, which now amount to 42.

In 1834 provision was made for a State School Fund (out of the sale of lands in Maine, and claims of the State on the government of the United States for military services, to which have since been added other sources), which was originally limited to $1,000,000, but from time to time the maximum was raised, until in 1872 the capital was $2,233,366. In the same year the employment of children under the age of fifteen years, in any manufacturing establishment was forbidden, unless such child had attended some public or private school taught by a teacher qualified according to law, at least three of the twelve months next preceding, on a forfeiture of $50 for each offense, for the use of the common schools in the town. This provision has been modified from time to time, until now the main object of school attendance, the elementary instruction of such children, is secured.

In 1836 the school laws were revised, and appear on the statutes under the title of 'Public Instruction.' In this revision the school committee are required to include in their annual school returns the number and attendance in all private schools and academies. 'No apportionment of the income of the school fund can be paid to any town which does not make the return required by law, or raise by taxation, for the wages of teachers only, a sum equal to one dollar for each person belonging to such town between the ages of 4 and 16.' This sum has been increased until it now stands at $1.50 for each person between 5 and 15.

In 1837 the legislature authorized the expenditure of $20 for each district for the purchase of a district school library. To supply the want of books suitable for this purpose, the State Board caused to be prepared a selection of books, entitled 'The School Library,' consisting of two series, one for children 10 and 12 years of age and under, and the other for advanced scholars and their parents. This action of the Board, however, met with considerable opposition, as being meant to control the reading facilities of the public, and the enterprise, after reaching thirty volumes, was abandoned by them. To encourage districts in the purchase of school libraries, the State appropriated to each district of sixty children between the ages of 4 and 15 years, the sum of $15 towards the purchase of the same; and for districts having over sixty children, the sum was increased proportionately to the number. In 1843, any town or city in the commonwealth was authorized to raise and appropriate to school libraries a sum equivalent to $15 to each grouping of sixty children, which in 1851 was extended to maintaining a public library for the use of the inhabitants of the town, and providing the same with suitable rooms under proper regulations for its government; and to appropriate annually a sum not exceeding fifty cents for each of its rateable polls in the year next succeeding that in which such appropriation is made.

Social libraries may be established by seven or more proprietors associating themselves into a corporation for the purpose of establishing, extending, or enlarging such library. According to the returns of 1872, there were 60 city and town libraries, with an aggregate of 500,000 volumes, beside 265 social libraries, with 643,866 volumes.

In 1837, school districts were authorized to raise money to establish and maintain a common school library and apparatus for the use of the children therein, to the amount of $50 for the first year and $10 for each succeeding year. This provision has been modified until now all towns and cities may establish libraries by tax.

In the same year, in place of a State Superintendent, as asked for, a Board of Education was instituted, to consist of the Governor, Lieutenant-Governor, and ten persons, holding their offices respectively for eight years, whose duty it was made 'to submit to the legislature in a printed form annually an abstract of the annual school returns made by the town committees; 'to appoint a secretary, who, under their direction, shall collect information of the actual condition and efficiency of the common schools, and other means of popular education, and to diffuse as widely as possible through every part of the commonwealth information as to the most approved and successful methods of arranging the studies and conducting the education of the young, to the end that all children who depend upon common schools may have the best education which they can be made to impart; and to submit annually to the legislature a detailed report of all its doings, with such observations as their experience and reflection may suggest upon the condition and efficiency of our system of popular education, and the most practicable means of improving and extending it.' Of this board, Horace Mann, at the time President of the Senate, was made Secretary.

In 1838 the school committee are required 'to make annually a detailed report of the condition of the several public schools, designating particular improvements and defects in the methods or means of education, to be read in open town meeting, or be printed and distributed for the use of the inhabitants, deposited in the office of the clerk of the town, and an attested copy transmitted to the secretary with the official return required by law.' The committee must also select and contract with the teachers in the town and the districts,' unless the town shall determine otherwise in respect to the districts; must enter in a record-book all their proceedings, and deliver over the same, at the expiration of the year, to their successors in office; shall fill up all the blanks and answer the inquiries in the form of return prescribed by the State Board, and cause the school register prescribed by said Board to be faithfully kept in all the town and district schools.' The committee thus charged with new and important duties are required to be paid 'one dollar each per day, and such additional compensation as the town may allow.' In the same year the secretary, in addition to his other duties, is required 'to attend in each county a meeting of teachers, school committees, and friends of education generally, and diligently apply himself to the object of collecting information of the condition of the public schools of such county, of the manner in which school committees fulfill the duties of their office, and the condition of the districts in respect to teachers, pupils, books, apparatus, and methods of education, in order to furnish requisite material for the report of the Board.'

In the same year, the establishment of special institutions for qualifying teachers for common schools, first systematically presented by Thomas H. Gallaudet and James G. Carter in periodicals in 1824–5, and issued in pamphlet form in the year following, and subsequently advocated almost every year in educational conventions and addresses, and particularly after 1835 by Rev. Charles Brooks, was secured by the offer of the sum of $10,000, by the Hon. Edmund Dwight, of Boston, then a member of the State Senate and of the Board of Education, on the condition that a like sum should be appropriated by the State for the same object. The offer was accepted, and the sum of $10,000 appropriated by the State, and both sums placed at the disposition of the Board of Education; and three schools were opened at Lexington, Bridgewater, and Barre.

In 1839 every school averaging 50 scholars was required to employ a female assistant, and contiguous districts were authorized to associate for the purpose of maintaining a Union school for the older children of such associating districts. This (and a similar Act in Connecticut of the same year) is the germ of the whole system of Union and Graded schools, which now prevails in every State.

In 1840 a vigorous attempt was made in the legislature to reverse the policy of a State provision for educating teachers, by returning to Mr. Dwight the gift made by him to the State for this purpose, and to abandon all State supervision of schools; and at one period it was anticipated by Gov. Everett, and Mr. Mann, that the proposition would succeed by a small majority in both Houses.

In 1841 the town of Springfield appropriated the sum of $1,000 as a salary for the Superintendent of Public Schools, to be selected and appointed by the town committee. This office was filled by the appointment of S. S. Green, afterwards Professor in Brown University, and was an important step in the improvement of school supervision in Massachusetts. Several other towns followed the example of Springfield. But in Lowell the right of the town to appoint such officer was contested, which led to the passage of an Act in 1854 requiring the school committee to appoint a superintendent wherever the town or city shall so determine, and gradually the practice of appointing a superintendent has extended to all the cities and many large towns. In Boston, after the subject had been discussed for years in the School Committee and City Council, the office was created in 1851, and filled by the appointment of Nathan Bishop, at that time occupying the same position in Providence since 1839, the earliest officer devoting his whole time to the work, in the United States.

In 1842 the sum of $6,000 annually for

three years was appropriated to continue the Normal Schools which were for the first time designated State institutions, and the policy of district school libraries was extended to towns and cities.

In 1845 an important decision was made by the Supreme Court, by which the right of all the towns to vote such sums of money for the support of town schools, and to make the public schools as good, as long, and as numerous as in the exercise of an honest discretion they may deem it expedient, was affirmed. In this case the town of Newburyport had provided for the support of all the schools, including the town grammar school, required by law, and also voted to raise money for the support and did support a Female High School for the purpose of teaching book-keeping, algebra, geometry, hygiene, mental, moral, and natural philosophy, the Latin and French languages, and other higher branches than were taught in the grammar schools of the town. The court held this to be a town school within the meaning of the revised statutes, and the money for its support could be legally raised by tax.

In 1846, Teachers' Institutes which had been held by Mr. Mann for the first time in 1845, by aid of $1,000 given by Hon. Edmund Dwight, were provided for by an appropriation of $2,000 from the school fund, since increased to $3,600.

In 1847, cities and towns were authorized to appropriate money for the support of schools for the instruction of adults in reading, writing, English grammar, arithmetic, and geography; and in the same year the offer of Theodore Lyman to aid in the establishment of an institution for the instruction, employment, and reformation of juvenile offenders, was accepted, and the State Reform School at Westborough was begun; and an annual appropriation made to furnish books to the inmates of the State Prison, which was afterwards extended so as to secure instruction in reading and writing to all prisons and houses of correction.

In 1848, wherever a suitable site for a school-house can not be secured by voluntary purchase, the same may be condemned for public uses, and the owner properly indemnified. In the same year an appropriation was made for training and teaching idiotic children of indigent parents for three years, which resulted in the establishment of the institution for that class at South Boston in 1851.

In 1849, all willful interruptions and disturbances of schools were punishable by fine and imprisonment, and provision was made for the preservation of all school reports and other documents in the school libraries; and the State Library was made the office of the Board of Education, and the secretary made librarian, with instructions to provide for the display of apparatus, &c. A copy of Barnard's *School Architecture* was furnished to each town, and an annual appropriation of $150 was made to the State Teachers' Association, and similar sums were afterwards voted to this and to the county associations.

In 1850, physiology and hygiene were added to the branches to be taught, and teachers were required to be examined into their abilities to teach the same. Towns were authorized to abolish school districts, and take possession of the property of the same, and provide for the erection of school-houses at the common expense of the town. In the same year, cities and towns were authorized 'to make all needful provision and arrangements concerning habitual truants, and children not attending school, without any regular lawful occupation, growing up in ignorance, between the ages of 6 and 15 years.' The Board of Education was authorized to furnish a copy of either Webster's or Worcester's large Dictionary of the English Language to every school district, and every school, except primary. In the same year provision was made for an Agricultural College, which did not take form and location till Congress made in 1862 the Agricultural and Mechanical College land grant.

In 1851 the Board of Education was authorized to employ two or more suitable persons to visit the towns and school districts, for giving and receiving information in the manner of the secretary of the Board; and to publish for general distribution selections from the reports of the Board.

In 1853, the legislature established a system of State scholarship 'to aid in qualifying principal teachers for high schools,' by assisting to educate and train forty-eight young men, 'of irreproachable moral character, free from any considerable defect of sight and hearing, and of good health and constitution,' in the different colleges of the State. Before the details of the system could be perfected by actual experience, particularly in the direction of practical training, and in the final step of inducting these teacher graduates into the schools, first as assistant, and afterwards as principal, the law was repealed, and the most beneficent measure was lost for a quarter of a century, at least.

In 1857, towns were authorized to establish and maintain day or evening schools for the education of persons over fifteen years of age—and thus legalized the practice of evening schools already introduced in several cities (in Boston in 1836, in New Bedford in 1848, in Lowell in 1853).

In 1870, after nearly fifty years of suggestion, discussion, and isolated experiments, drawing was included by act of the legislature (May 16) 'among the branches required to be taught in the public schools,' and 'any city and town having more than ten thousand inhabitants were required to make provision for free instruction in industrial or mechanical drawing to persons over fifteen years of age, in day or evening schools, under the direction of the school committee.' Thus was consummated one of the suggestions of the commissioners appointed by the legislature in 1825, that drawing should be made part of the curriculum of their proposed State institution for instruction in the practical arts and sciences; and of the slate and blackboard exercises presented by Josiah Holbrook and William A. Alcott from 1830 to 1842, and of Mary T. Peabody (Mrs. Horace Mann) in her Primer of Drawing, and of Mr. Barnard in his Manual of Methods for Common School Teachers in 1839–41; and of Mrs. William Minot in her first instructions to a class in the Franklin school in 1839, and to all the teachers of the primary schools of Boston in 1841–42.

In 1871 the legislature appropriated $10,000 out of the income of the school fund for the salaries and expenses of special agents of the Board of Education, the object being, first, to 'secure the services of a competent agent to give aid and direction to a more systematic and thorough course of instruction in drawing in the Normal Schools; to visit the cities and towns required by the law of 1870 to maintain schools or classes for instruction in mechanical drawing; to give information and assist school committees in the formation of such classes, and in the management of suitable courses of instruction in them; and to advise and aid a practical method for the education of teachers in drawing for special schools and for the common schools in this branch.' The second object was the employment of competent persons to act as special agents of certain designated districts in coöperation with the labors of the general agent, with the view of reaching all the towns in the commonwealth, annually, by a direct and thorough system of inspection, and independent of, and at the same time in coöperation with, that of the town committees. It was to do, in part, in Massachusetts the work of county superintendents in the system of Pennsylvania, Illinois, and several other States. This feature was part of the original school law prepared by Mr. Barnard in 1844 for Rhode Island.

The first object was secured by the employment of Mr. Walter Smith, art master in one of the prominent schools (at Leeds) in connection with the English department of art and science, as professional adviser and lecturer in art education, with the title of State Director of Art Education.

In 1872, the fifth State Normal School was located at Worcester, and $60,000 appropriated for a building on a site appropriated for its use,—a sum which measures the progress of public opinion towards these institutions, the first institution, in 1838, not receiving a dollar towards such expenditure, and the three only $5,000, after an experience of four years of their utility. They are now regarded as indispensable in any system of public instruction.

The statistics of public schools and State expenditures for educational purposes in 1871 were as follows: total amount of taxes paid to maintain public schools, $5,462,852; and total expense, exclusive of collegiate and professional education $6,297,010; $22.63 for each person between the ages of 5 and 15 years. Among the items are—$3,272,335 for the wages of teachers; $122,086 for town and city supervision and printing reports; number of public schools 5,076 (including 181 high schools), with 273,661 pupils; number of normal schools (State and city) 6, with 1,100 pupils; teachers' institutes held, 7, with an attendance of 908 teachers. Among the charges on the income of the State School Fund were $3,400 for secretary; $4,224 for agents; $10,627 for printing report and expenses of board; $41,427, State Normal Schools; $3,000, Institutes; $800, State Teachers' Association; $225, County Associations; $500, American Institutes.

MICHIGAN.

Michigan was settled as early as 1650, organized as a territory in 1805, and admitted a State in 1837, with an area of 56,451 square miles, and a population in 1830 of 31,639, which had increased in 1870 to 1,184,049, and taxable property to the value of $272,242,917.

The constitution adopted in 1835 ordains the appointment of a superintendent of public instruction, consecrates the proceeds of all land grants for educational purposes, to such purposes and no other, provides for a common school in each school district for at least three months in the year, and the establishment of libraries, at least one in each township, and a university for the State.' Under these provisions, that of a State Superintendent and township libraries being in advance of other States, the system of public instruction was organized, and these cardinal features were not materially altered by the Constitution of 1850; except the legislature is enjoined to provide within five years for the establishment of a 'system of primary schools, in which a school shall be kept without charge for tuition, for at least three months in each year in every school district, and all instruction conducted in the English language.' The university is placed under the charge of a Board of Regents, one for each judicial district, elected at the same time, and for the same term, as the judge of that circuit. A State Board of Education is also created, of which the Superintendent is member and secretary, and to which the State Normal School is committed. To these State officials the law has added, County Superintendents, one for each county, elected by the people of the county; Township Inspectors, three for each congressional township; District Boards for the local management of the schools; and Boards of Education for the cities and large villages.

The system of public instruction in Michigan started under favorable auspices—the early settlers having come from States where common schools had been the main reliance of the people for the education of their children, and having located in neighborhoods, they enjoyed the facilities of at once organizing schools after the old type. The framers of the first constitution, and of the early legislation, were graduates of the academies and colleges of New York and New England, and into the educational movement from the start, as soon as agitated elsewhere, were introduced the agencies and institutions which have proved useful in the older States. A School Journal was started in 1838; a school convention was called in the year following; and was soon followed by county teachers' associations and the State Teachers' Association in 1853; a Teachers' Institute was held in 1846, and every year since there has been several such brief professional courses, and a State Normal School has been in operation since 1859; the permanent university was opened to receive pupils within two years after the State had adopted a constitution, and was allowed, with the assistance of the State, and in anticipation of its special endowments, to get its foundations laid, and its different schools organized before denominational institutions were chartered to draw off the pupils and enlist the interest of localities in rivalry, if not in antagonism. Under these advantages the munificent provisions of Congress have been better cherished and applied up to that time than in the other Western States, and her example has had a powerful influence in inaugurating better methods of management.

The system of public instruction embraces: (1,) Primary schools—so extended and so expansive in their organization as to meet the wants of 5,000 rural districts, where the sparseness of the population renders only one school for pupils of all ages possible, and at the same time, by allowing of gradation in 256 villages and cities, to fill up all the educational demands below the university and special schools—doing away with the necessity of incorporated academies and college preparatory schools. This higher, or secondary institution is not yet fully developed, but the germ and capacity is in the system, and is partially worked out in Detroit and other cities. According to the superintendent's report, there were 273,682 pupils, under 11,014 teachers (8,221 females), whose wages amounted to $1,398,328; in school-houses which cost $6,234,797. The total school expenditure for the year 1870 was $3,154,-221. Of this $175,000 was income of the Primary School Funds (capital $2,700.834, with 468,713 acres unsold), and the balance was State, town, city, and district property taxation, the rate bills paid by parents up to 1869 having been abolished. Of the teachers engaged in the schools nearly 1,000 are graduates of State Normal Schools or higher educational institutions, and 2,005 attended the 16 institutes which were held in as many different and widely separated localities in 1870.

(2,) The Union and High Schools although belonging to secondary institutions, are returned under the primary schools. Of the semi-public schools—the incorporated academies, and colleges, and the private classical schools, no returns are made.

(3,) The University, with its professional schools, is part of the system of public instruction, and in 1870 reported 1,126 students, viz., 477 in the department of science, literature, and the arts; 340, of medicine and surgery; 309, of the law. The expenses of the institution for the year were $70,167, met by the income of the University Fund ($564,443, with 200 acres unsold), and an appropriation from the State treasury. The State has recently assigned the avails of a special tax in aid of the university; all the schools of the institution are open to all citizens of the State without distinction of race or sex.

(4,) State Agricultural College at Lansing—founded in 1855, in pursuance of the constitutional requirement of 1850, on a farm of 676 acres, and with a special fund, not yet realized, for its support, but with an annual appropriation of $30,000 from the State treasury towards its expenses, in addition to over $100,000 paid towards its buildings and equipment in 1870. There were 129 students, of whom 10 were females.

(5,) State Normal School at Ypsilanti, with 90 pupil-teachers in the training department. This school was founded in 1849, on an endowment of a portion of the salt spring lands and swamp lands, out of which a capital of $67,616 has been realized, leaving land unsold, which it is estimated will increase the capital to $300,000.

(6,) Other Special Schools are the institutions for deaf mutes and blind at Flint, founded in 1854; the State Reform School at Lansing, opened in 1856.

(7,) The public library feature of the system of public instruction ordained in the constitution has not been developed satisfactorily in most townships. In Detroit alone has it become a prominent institution, numbering 20,000 volumes in 1872.

The aggregate expenditure by the State, from funds and property taxation, in 1870 exceeded $4,000,000.

MINNESOTA.

Minnesota was organized as a Territory in 1849, and admitted as a State in 1850, with an area of 83,531 square miles and a population in 1860 of 172,413, which had increased in 1870 to 439,706, with taxable property to the value of $84,135,332.

The Constitution of 1850 provides for a general and uniform system of public schools in each township by taxation or otherwise, and a university for the State.

The State has received from Congress 2,969,790 acres for schools, 46,080 for a university, and 120,000 for a college of agriculture and the mechanic arts. The State Auditor for 1872 reports the permanent school fund already realized at $2,532,351, and the avails of other educational lands sold at $500,000 more.

The authorities for administration are:

(1,) State Superintendent appointed by the Governor and Senate at a salary of $2,-500, who must meet with the county superintendents for discussions of all matters relating to the schools, and hold teachers' institutes as far as practicable in the different counties, and encourage county conventions of teachers.

(2,) County Superintendents for such counties as elect so to do, through the County Commissioners, who examine teachers after thirty days' notice of the time and place, and issue three grades of certificates and revoke such license for adequate cause; visit all the schools in the county, and conduct in each county one institute for the instruction of teachers each year; encourage teachers' associations, and disseminate information respecting improved methods of teaching, school construction and equipment, and report annually.

(3,) District Trustees—composed of director, treasurer, and clerk, elected by the voters in districts and sub-districts created by the County Commissioners, to have charge of all school matters in such districts, subject to the action of the State and County Superintendents.

(4,) Board of Education for independent school districts (cities, villages, &c., having over 500 inhabitants), composed of six members, two elected each year for a term of three years, with power to appoint a district superintendent (to visit schools, and assist teachers in the classification and promotion of the pupils), and district examiners, to examine candidates for the office of teacher, &c.

In 1872 the State disbursed $171,881 for the 'State Institutions,' viz., $26,212 for Normal Schools; $10,000 for Insane Asylum; $20,000 for deaf mutes and blind; $12,009 for State Reform School; $12,506 for soldiers' orphans; and $331,161 for State Prison;—total, $171,981.

The national census for 1870 returns 12,747 persons over 10 years of age who can not read, and 24,413 who could not write.

### MISSISSIPPI.

Mississippi was organized as a Territory in 1798, and admitted as a State in 1817, with an area of 47,156 square miles and a population in 1820 of 75,458, which had increased to 827,822 in 1870, with taxable property estimated at $177,288,892.

By act of Congress in 1803, section 16 in each township is reserved for the support of schools, and 36 sections for the use of Jefferson College, chartered by the territorial legislature in 1801, and two town lots in the town of Natchez, and an out lot not exceeding 30 acres, for the same college. In 1819 another township, or a quantity equivalent thereto, was donated to the State for the use of a seminary of learning. It was stated in a special message of Governor McRae to the legislature in 1856, that the total amount of the Seminary Fund in the treasury of the State, and for which the State was responsible, was nearly $1,200,000. In 1870 the legislature appropriated $50,000 a year for ten years to the support of the university.

The Constitution of 1817 contains a clause from the ordinance of 1785: 'Religion, morality and knowledge being necessary to good government, the promotion of liberty, and the happiness of mankind, schools and the means of education shall forever be encouraged.'

The Constitution of 1868 provides for the election by the people of a superintendent of public education, at the same time and manner as the governor, to hold his office for a term of four years and until his successor shall be elected, and whose duty it was to submit to the legislature for its adoption within twenty days after its first session under the constitution, a uniform system of free public schools. It also provides for a Common School Fund out of the consolidation of the congressional township fund, the swamp lands, escheats, fines for penal offenses, and authorizes a poll tax, not to exceed two dollars *per capita*. No religious sect or sects shall ever control any part of the school or university fund.

The system of free public schools adopted by the legislature in 1869 provides for: (1,) State Superintendent; (2,) State Board, composed of the State Superintendent, the Secretary of State and the Attorney General, whose duties are confined to the investment of the school funds; (3,) County Superintendents, of which there are 70, and (4,) District Boards in each county, who have the local management of schools. Each county is made a school district, which can be divided into sub-districts for the management of local schools. A State Normal School exists at Holly Springs, and a Teachers' Institute must be held annually in each Congressional district. In 1870 there were 98,600 pupils enrolled out of a school population of 304,762, in 3,450 public schools, under 3,520 teachers. According to the census there were 291,718 persons over 10 years of age who could not read, and 313,313 who could not write.

### MISSOURI.

Missouri was first settled in 1763 and admitted into the Union in 1820, having an area of 67,380 square miles, and a population in 1820 of 66,586 (10,222 slaves), which had increased in 1870 to 1,721,295 (118,071 colored), with a valuation of taxable property of $556,129,969.

The constitution of 1820 provides for the security of school lands (section 16 in each township, or 1,199,139 acres, and 36 sections, or 46,080 acres, for a university), and enjoins 'the establishment of one or more schools in each township, as soon as practicable and necessary, where the poor shall be taught gratis.' But little progress was made outside of St. Louis until after the constitution was revised in 1865.

In St. Louis, under the Territorial legislature, 'a Board of Trustees for schools in the town of St. Louis,' was organized in 1817; but this Board did little more than legally assert the claims of the city to certain out-lots, which were more vigorously prosecuted by the new Board constituted in 1833, when these claims were converted into a fund which already amounts to over $1,000,000, and yielded in 1871 an income of $53,000. The first school was opened in 1838, and the first building was erected in 1842 at a cost of $10,000; and in 1871 the buildings owned by the city and occupied by the public schools were valued at $2,000,000, the schools having increased from two in 1841, with 350 pupils, to sixty-eight in 1871, with an enrolled attendance of 31,221 pupils, under 559 teachers, and maintained at a cost of $723,362. The schools consist of one Normal School for female teachers; one High School for boys and girls; one intermediate school for boys and girls; twenty-seven district schools in which pupils are classified according to age and attainments in the primary and grammar divisions; six separate schools for colored scholars; sixteen evening schools culminating in a higher industrial school; and a public school library of 10,000 volumes.

The first general law was passed in 1820, but repealed in 1825 by an act 'for establishing and governing common schools' through commissioners of the school land in each township, appointed by the county commissioner and trustees in each district, which shall be laid out and constituted by the same county officers. Under this act, in a few townships, schools were opened, but nothing effectual was done until 1837, when a State fund was instituted out of the proceeds of the saline lands and the State's proportion of the United States surplus revenue. This fund has increased to $2,-253,000 in 1872.

In 1853 the office of Superintendent, which had been associated with that of Secretary of State, was made independent and elective by the people, and commissioners were appointed for each county. Under this new act the schools were multiplied, but the system did not attain any efficiency until the revision of the constitution, and the school law in pursuance thereof, in 1865. By the constitution of that year the Legislature must maintain 'common schools for the gratuitous instruction of all persons between the ages of 5 and 21 years, and establish separate schools for children of African descent.' Their supervision is vested in a Board of Education, of which Board the Superintendent is made President.' 'No township can receive any portion of the public fund unless a free school shall have been kept therein for not less than three months during the year for which the distribution is made; and every child of sufficient mental and physical ability can be required to attend the public schools between the ages of 5 and 18 for a term equivalent to sixteen months, unless educated by other means.' 'To supply any deficiency in the public school fund to sustain a free school, at least four months in every year, a property tax may be levied in each county, township, or school district, as the General Assembly shall provide. In the distribution of the State fund, any inequality in the county, town, or city local funds may be corrected.'

Under the operation of the law of 1865, the schools have increased from 4,840 to 7,547; the teachers from 6,262 to 7,881, and children in attendance from 169,270 to 280,472. But with this increase there is yet a great work to be done in Missouri. According to the census of 1870, out of 577,803 between the ages of 5 and 18 years, only 324,348 attended any school in the year preceding; and there were 146,771 persons over 10 years of age who could not read, and 222,411 (206,827 natives and over 130,000 whites) who could not write.

The State Auditor's report for 1872 gives a few items of disbursements for educational purposes: Superintendent, assistant, and contingent expenses, $6,348; blind asylum, $27,500; deaf mute asylum, $29,500; State school moneys paid to the counties, $355,-427; Normal Schools (Teachers' Institutes, &c.), $17,000; Agricultural College, $8,500; township funds (16th section), $2,271,582; seminary fund (university or the 36 sections), $108,700; Congressional Agricultural College grant, 330,000 acres, with 640 acres given by Boone County.

### NEBRASKA.

Nebraska was organized as a Territory in 1854, and admitted as a State in 1867, with an area of 75,995 square miles, and a population in 1870 of 122,993, and taxable property of $56,584,616. The Constitution of 1867 provides that all 'educational funds accruing out of the sale of all lands or other property granted or intrusted to the State for educational and religious purposes, shall forever be preserved inviolate and undiminished, and the income thereof shall be applied to the specific objects of the original grants or appropriations, and no religious sect or sects shall ever have any exclusive right or control of any part of the school funds of the State.' The legislature must secure a thorough and efficient system of common schools throughout the State.

The school lands were estimated by a committee of the Constitutional Convention to exceed 3,000,000 acres, which, if sold at the minimum rate recommended, would give a permanent fund estimated by the same committee at $15,000,000.

The system now in operation under the school law of 1866 is administered (1,) by a State Superintendent; (2,) 40 County Superintendents, one for each county, elected by the people, subject to the rules and instructions of the State Superintendent; (3,) trustees for the several districts. Teachers are examined by the County Examiners, and receive three grades of certificates running for different periods of time, according to their qualifications. The law requires a County Institute organized under the County Superintendent, and an Institute for a wider territory by the State Superintendent.

In 1870 there were 1,032 organized school districts, with 41,063 children between the ages of 5 and 21 years, of whom 23,158 attended school under 1,080 teachers, whose wages amounted to $145,975. The cost of school-houses and value of school lots is returned at $445,538, and the total expenditure for all purposes for the year was $363,524.

### NEVADA.

Nevada was organized as a Territory in 1861, and admitted as a State in 1864, with an area of 81,539 square miles, and a population in 1863 of 43,000, which in 1870 as given by the census, stood at 42,491, with taxable property valued at $25,740,973.

The Constitution of 1864 enjoins the legislature 'to encourage, by all suitable means, the promotion of intellectual, literary, scientific, mining mechanical, agricultural and moral improvements, provide for the election of a superintendent of public instruction, and the establishment of a uniform system of common schools, by which a school shall be established in each school district for at least six months in each year; and any school district neglecting to establish and maintain such school, or which shall allow instruction of a sectarian character therein, shall be deprived of its portion of the interests of the public school fund during such neglect or infraction. The legislature is authorized to pass such laws as shall secure a general attendance of the children at school. The 16th and 36th sections in every township, the 30,000 acres for each senator and representative in Congress by act of 1862, the 500,000 acres granted to new States in 1841, all escheats and fines for penal offenses, shall be held and used for educational purposes, the interest thereof only to be applied as directed in the laws donating the same. 'The legislature shall provide for a State university, which shall embrace departments of agriculture, mechanic arts and mining, and is authorized to establish normal schools and schools of different grades, from the primary school to the university, 'in which no sectarian instruction shall be imparted or tolerated.' A special tax of one half of one mill on the dollar of all taxable property, must be provided for the maintenance of the university and common schools. The governor, Secretary of State and Superintendent are constituted a Board of Regents to manage the university funds and affairs.

The school law of 1865, and amended in 1867, makes it the duty of the State Superintendent to convene an institute of teachers annually, and visit each county for the purpose of addressing public assemblies on subjects pertaining to common schools, and consulting county and other school officers. In 1870 there were 2,883 pupils out of 3,952 children between the ages of 6 and 18 years, under 53 teachers; and 727 persons over 10 years of age who can not read, and 872 who can not write.

### NEW HAMPSHIRE.

By the first national census in 1790, New Hampshire had a population of 141,899, which had increased in 1870 to 318,300, on an area of 8,280 square miles, and with taxable property to the value of 149,065,290.

The first settlements within the present limits of New Hampshire were made from Massachusetts at Dover and Portsmouth in 1623, and down to 1680 all the settlements were treated as belonging to the county of Norfolk; and for brief periods afterwards it was united to Massachusetts, and the school policy of that colony prevailed generally in its legislation as an independent province. In the first constitution of New Hampshire, adopted in 1784, the language introduced by John Adams into the second section of the article on education in the constitution of Massachusetts, relating to the encouragement of literature, the sciences, and seminaries of learning, was followed literally.

In 1789 a general school law was passed, repealing all former acts on the subject, and providing: (1,) That the selectmen of the several towns and parishes shall assess annually the inhabitants of the same according to their polls and rateable estate, in a sum to be computed at the rate of five pounds for every twenty shillings of their proportion for public taxes for the time being, 'to be applied to the sole purpose of keeping an

English grammar school or schools for teaching reading and writing and arithmetic within the towns and parishes for which the same shall be assessed; except such town be a shire or half-shire town, in which case, the school by them kept shall be a grammar school for the purpose of teaching the Latin and Greek languages, as well as reading, writing and arithmetic aforesaid; and in failure to assess, collect and apply this tax in the manner set forth, the selectmen must pay out of their individual estates, for the benefit of the town schools, a sum equal to that in which they may be found delinquent,' on the requisition of the town clerk, whose duty it is made to look after this matter. (2,) 'No person shall be deemed qualified to keep a town public school, unless he shall produce a certificate from some able and reputable schoolmaster and learned minister, or preceptor of some academy, or president of some college, that he is qualified to keep such school.'

These simple and salutary provisions, coupled with another dating back to 1691, empowering the towns to build suitable school-houses by tax on the rateable estates of the inhabitants, rigidly enforced would have kept up a system of public instruction on a uniform basis over the state, when, unfortunately, in 1805 the towns were authorized to divide their territory into districts; and school districts thus constituted were authorized to provide school accommodation, appoint a local committee, and in general to manage the public school in their own way. The lack of intelligent, vigilant, and responsible town inspectors over the district schools in which the local management was left to themselves, and the establishment of academies in the large centers of population and business, which met the wants of the educated, were followed with the same real or relative deterioration which characterized the common schools of New England, generally.

The subject of school improvement attracted attention as early as 1830, in the lyceum movement conducted by Josiah Holbrook, and was continued by county common school conventions and associations begun in 1836. The first state convention was called in 1843; the first teachers' institute held in 1845; the office of state commissioner of common schools was instituted by the Legislature in June, 1846; and the duty of the State in respect to the supervision of schools, which it makes obligatory on the towns, has since been recognized in some form, and at present by a State Board constituting the Governor and council, and the Superintendent of public instruction acting through county commissioners, or rather through a commissioner for each of the eight counties into which the State is divided. A private Normal school was instituted in 1845 at Reed's Ferry by Prof. Wm. Russell, and a State Normal school established in 1870 at Plymouth.

To supply the want of the old town grammar school, an act was passed in 1837 giving to the town of Portsmouth, and any other town which chose to adopt the provisions of the act, authority to establish two high schools, one for males and the other for females, and provide for a graded course of studies in connection with the district schools. The same authority was given to central districts by the Act of 1848.

In 1872 there were 2,452 common schools taught in 2,284 districts, located in 232 towns, with a registered attendance of 72,672 pupils, under 3,826 teachers (3,241 females). The whole amount raised for school purposes was $468,527, of which $11,565 was paid the superintendents of town committees for their services. The buildings and sites of school-houses were valued at $1,870,000. According to the census of 1870 there were 7,618 persons over ten years of age who could not read, and 9,926 who could not write.

Various attempts have been made since 1846 to protect children under fifteen years of age employed in factories and other manufacturing establishments from excessive labor, and secure to all children elementary instruction, which culminated in 1871 in 'An Act to compel children to attend school,' which ordains that all parents, guardians, or masters of any child between the ages of eight and fourteen, residing within two miles of a public school, shall send such child at least twelve weeks in each year, six of which must be consecutive, unless such child shall be excluded from such attendance on the ground of physical or mental inability to profit by such attendance; or is instructed in the same period in a private school or at home, under penalties for violation, $10 for the first and $20 for each subsequent offense, to be recovered as in an action of debt. A penalty attaches to school officers for not executing the law.

NEW JERSEY.

New Jersey was first settled in 1627, and adopted its first constitution as a State in 1776, with an area at that time of 8,320 square miles, and a population in 1790 of 184,139, which in 1870 had increased to 906,096, with a valuation of taxable property of $624,868,971.

The constitution of 1776 contains no allusion to schools or education; nor prior to the colonial period was there any legislation respecting common schools. In 1816 an act to create a fund for the support of free schools was adopted, and the first distribution of its income took place under the act of 1829, passed 'to establish common schools.' By this act towns were authorized to raise money to support schools by tax, and must raise in this way a sum sufficient to entitle it to any portion of the income of the school fund; but it was not till ten years later that towns were compelled to raise a specified sum every year, nor till 1871 that the schools were made free by a State school tax of 2 mills on the valuation.

The first educational convention in the State was held in 1828, at Trenton, and from that time the subject of school improvement was agitated in county and state meetings until 1838, when a large meeting of delegates from every part of the State was held at Trenton, presided over by Chief Justice Hornblower, and the address of which to the people of the State was drawn up by Rt. Rev. Bishop Doane. From this rousing address we make a brief extract:

We address you as the sovereign people, and we say that it is your duty and your highest interest to provide and maintain, within the reach of every child, the means of such an education as will qualify him to discharge the duties of a citizen of the Republic; and will enable him, by subsequent exertion, in the free exercise of the unconquerable will, to attain the highest eminence in knowledge and power which God may place within his reach. We utterly repudiate as unworthy, not of freemen only, but of men, the narrow notion that there is to be an education for the poor as such. Has God provided for the poor a coarser earth, a thinner sky, a paler air? Does not the glorious sun pour down his golden flood as cheerily upon the poor man's hovel as upon the rich man's palace? Have not the cotter's children as keen a sense of all the freshness, verdure, fragrance, melody and beauty of luxuriant Nature as the pale sons of kings? Or is it on the mind that God has stamped the imprint of a baser birth, so that the poor man's child knows with an inborn certainty that his lot is to crawl and not to climb? It is not so. God has not done it. Man can not do it. Mind is immortal. Mind is imperial. It bears no mark of high or low, of rich or poor. It heeds no bound of time or place, of rank or circumstance. It asks but freedom; it requires but light. It is heaven-born, and aspires to heaven. Weakness does not enfeeble it. Poverty can not repress it. Difficulties do but stimulate its vigor. And the poor tallow-chandler's son that sits up all the night to read the book which an apprentice lends him, lest the master's eye should miss it in the morning, shall stand and treat with kings, shall add new provinces to the domain of science, shall bind the lightning with a hempen cord, and bring it harmless from the skies. The common school is common, not as inferior, not as the school for the poor men's children, but as the light and air and water are common.

The office of State Superintendent was created in 1846. The first County Teachers' Association was formed for Essex County in 1847, and the State Teachers' Association was formed in 1853. The first Teachers' Institute was held at Sommerville in 1851, and provision was made for their being held by the State for the first time in 1854. The State Normal School, after years of agitation was established in 1858. Special authority to the large cities to establish graded schools was given to the city of Patterson in 1836, and subsequently extended and exercised by most of the large cities.

The school authorities are: (1,) The State Board of Education, composed of the Governor, Attorney-General, Comptroller, Secretary of State, President of the Senate, Speaker of the Assembly, and the Trustees of the State Normal School; (2,) the Superintendent of Public Instruction, who is appointed by the Board, of which he is secretary, and who, with the Principal of the Normal School, constitutes a Board of Examination; (3,) County Superintendents, appointed by the Board, who, with the City Superintendents, elected by the City Boards of Education, constitute the State Association of School Superintendents; (4,) Township Board of School Trustees.

The means to support common schools in 1871 were: (1,) the income ($35,000) of the school fund (capital $792,190) and State appropriation ($65,000 to make), $100,000; (2,) township school tax, $44,467; district school tax, $18,144; surplus revenue, $31,-654; two mill State school tax, $1,168,803; appropriation for the State Normal, and Farnum Schools, $11,200;—total, for all purposes, $2,263,070. Total valuation of school buildings and grounds, $4,966,788.

Out of 258,227 children between the ages of 5 and 18 years, 161,683 were enrolled in public schools; of the number enrolled, 15,594 attended ten months, 21,801 eight months, 26,570 six months, 33,158 four and 63,429 less than four months.

NEW YORK.

New York, settled as early as 1609, had by the first national census of 1792, on an area of 46,000 square miles a population of 340,120, which had increased in 1870 to 4,382,759, with taxable property to the value of $1,967,001,185.

In the first constitution of 1777 there is no reference to schools; in that of 1822, the proceeds of all State lands are appropriated to a common school fund; and in the third of 1846, the capital of several educational funds at that time existing, are declared inviolate, and their revenues must be applied to the objects to which they are donated.

In 1784, the first session after the termination of the war, an act was passed to alter the name of Kings College, in the city of New York, to Columbia College, and to erect a university. This act was superseded in 1787 by another, which instituted the Regents of the University, and provides for the incorporation by them of colleges and academies. To this board has been given from time to time, duties which cover the common schools.

The first act for the encouragement of common schools was drafted by Adam Comstock, a native of Connecticut, in 1795, by which $50,000 were annually appropriated for five years to the several cities and towns, 'in which the children of the inhabitants residing in the State shall be instructed in the English language (taught English grammar), arithmetic, mathematics, and such other branches of knowledge as are most useful and necessary to complete a good English education.' The boards of supervisors were required to raise by tax a sum equal to one half of that appropriated by the State, to be applied in like manner. At the end of four years the appropriation was not renewed, and notwithstanding the efforts of Jedediah Peck, a native of Connecticut, and others, no efficient legislation took place till 1812.

In 1811, on the recommendation of Gov. Tompkins, a commission, with Mr. Peck chairman, was appointed to report a plan for establishing a system of common schools, which was done in 1812, after the commissioners had conferred with friends of education in different parts of the State, and studied the rise and progress of similar systems in neighboring States. The following are the outlines of their plan: 'That the several towns in the State be divided into school districts, by three commissioners, elected by the citizens qualified to vote for town officers; that three trustees be elected in each district, to whom shall be confided the care and superintendence of the school to be established therein; that the interest of the school fund be divided among the different counties and towns, according to their respective population, as ascertained by the successive census of the United States; that the proportions received by the respective towns be subdivided among the districts into which such towns shall be divided, according to the number of children in each, between the ages of 5 and 15 years; that each town raise by tax annually as much money as it shall have received from the school fund; that the gross amount of moneys received from the State and raised by the towns be appropriated exclusively to the payment of the wages of the teachers; and that the whole system be placed under the superintendence of an officer appointed by the Council of Appointment.'

These features were embodied in the act of 1812, and under the careful administration of Gideon Hawley, a native of Connecticut, as superintendent, the system went into operation, to gather strength and expansion from year to year, and contribute by its beneficent results to the establishment and improvement of common schools in other States.

In 1839, the superintendent (John C. Spencer) was authorized to appoint a County Board of School Visitors to serve gratuitously in their several counties, and so favorably received were the reports of these school visitors, that in 1841 the legislature, by a nearly unanimous vote, provided for the appointment by the Board of Supervisors for each county, biennially, of a County Superintendent, charged with the general supervision of the interests of the several schools under his jurisdiction. No previous act had imparted such general activity to school affairs as this; but in 1847 the office was abolished, and the supervision of the schools, examination of teachers, the appointment and disbursement of the school fund, were intrusted to a single officer in each town. In 1857, the operation of town supervision proving unsatisfactory, provision was made for the appointment of School Commissioners in districts. There were 135 city and district commissioners in 1871.

The law of 1812 provided for the support of schools out of the income of the school fund and a tax upon the towns equal to its distributive share of the school money, at first optional, but afterwards obligatory, through the county tax. In 1814, the trustees of the district were authorized to supply any deficiency in the means to pay the wages of teachers, by collecting it from the parents or patrons of the school in proportion to the attendance of their children. In 1849, the rate bills were abolished, leaving the deficiency, after applying the public money to the payment of teachers' wages, to be made up by district taxation. This act was submitted to the people, and approved by a vote of 249,872 in its favor, and 91,151 against it. In 1850 the Free School Act, as it was called, was repealed; but being again submitted to the people, the act itself was sustained. In 1851 the law was repealed, and the State taxation of $800,000 was levied, to be distributed with the school moneys in the support of schools, instead of the county tax, equal in amount to the annual distribution from the school fund. In 1856, to the State tax of $800,000, a levy of three-fourths of a mill upon every dollar of real and personal estate was made, which has since been increased to one and one-fourth of a mill, yielding in 1872 the net sum of $2,565,672.

To secure the services of well qualified teachers, and to exclude the incompetent and immoral, was a primary object with the commissioners who reported the original school law of 1811. This they aimed to effect by the appointment of inspectors to whom the examination of all candidates was given, and without whose certificate no teacher could be legally employed. This mode tested the attainments of candidates, but provided no way in advance of actual experience of acquiring the requisite knowledge whereby better qualifications could be had of principles and methods of teaching. To remedy this, Gov. Clinton in 1825 and in 1826 recommended a 'seminary for the education of teachers in those useful branches of knowledge already introduced in all our common schools,' and in 1828 he urges the establishment in each county of a Monitorial High School (after the model of one in Livingston County, under the charge of C. C. Felton—afterwards President of Harvard College), 'in which better methods of teaching shall be at once taught and exemplified.' In 1826, Mr. John C. Spencer, from the Literature Committee of the Senate (to whom the recommendations of the Governor had been referred), recommended that the income of the Literature Fund should be divided among the academies, not in proportion to the number of classical students, but to the number of 'persons instructed in each, who shall have been licensed as teachers of public schools by the proper board.' In 1827, Mr. Spencer, from the same committee, reported an act by which the Literature Fund was increased for the avowed purpose in the preamble 'of promoting the education of teachers,' 'the incompetency of the great mass of whom is radical and defeats the whole system, and the hopes and wishes of all who feel an interest in disseminating the blessings of education.'

In 1834, a portion of the income of the Literature Fund was set apart 'to be distributed by the regents to such academies, subject to their visitation, as will provide for the education of teachers for the common schools.' Under this provision, one academy was selected in each of the eight senatorial districts, in which was erected a department devoted to this particular work, known as the Teachers' Department; and in 1838, by an act appropriating the income of the United States Deposit Fund for the purposes of education, $28,000 was appropriated to the several academies on condition that 'the academies receiving any of its distributive share equal to $700 should establish and maintain a department for the instruction of common school teachers.' Under this provision the number of academies with this special course for teachers was increased to fifteen; and in 1871, under a revision of the previous legislation on the subject in 1855, 'the science of common school teaching' was taught to 'teachers' classes' in 87 academies, with a total attendance of 1,494 pupil teachers.

In 1840, Prof. Potter, of Union College (afterwards Bishop Potter, of Pennsylvania), in a special report founded on a personal visit to the academies having teachers' departments, recommends 'the establishment of one institution at the capital, devoted exclusively to the education of teachers.' The same recommendation was indorsed by the superintendent (John C. Spencer), in his report to the legislature of that year. In 1844, the committee on colleges, academies, and common schools, in the House of Representatives, through the chairman (Mr. Hulburt), after visiting the Normal Schools of Massachusetts reported a bill to establish a Normal School at Albany 'for the instruction and practice of teachers for common schools in the science of education and in the art of teaching,' appropriating $10,000 annually for five years for its support. This school, in a building furnished gratuitously by the city of Albany, went into operation in December, 1844; and, after a successful trial of four years, received in 1848 from the state a special appropriation to provide permanent accommodations, and an annual appropriation of $12,000 for its support. In 1863, aid was extended to the Training School at Oswego, which was formally recognized a State Normal School in 1866; and in 1864, provision was made for six other institutions located in different parts of the State; the citizens of Brockport, Fredonia, Cortland, Potsdam, Geneseo, and Buffalo having furnished suitable buildings at an aggregate expense of $500,000. The value of the grounds, buildings, and equipment of the State Normal Schools is estimated $829,739, and the annual expense to maintain them, at $150,000. With the Normal pupils are large schools and classes of children whose exercises are made subsidiary to the main object of the institution. In 1872, there were 5,807 students in attendance on the different departments of the 8 Normal schools.

In 1839, Francis Dwight secured the consolidation of all the school districts in Geneva, and inaugurated the union or graded system in New York; and in 1840 issued the first number of the District School Journal, a copy of which the superintendent obtained authority to send to every school district.

By the Union Free School Act of 1853, cities and villages divided into districts were enabled to consolidate for the purpose of maintaining graded schools, and for making them free in advance of the general free school act of 1867. Under the operation of this act, more than ninety academies included within the limits of such districts were absorbed into the general system, becoming the High Schools of the united districts. The whole number of such schools in 1870 was 694.

In 1835, the first legislative provision for school libraries was made. To James Wadsworth of Geneseo, a native of Connecticut, belongs the credit of originating the system of district school libraries. In 1811, in a letter addressed to one of the commissioners appointed by Gov. Tompkins to report to the legislature a system for the organization and establishment of common schools, Mr. Wadsworth (after giving the outline of the system of common schools actually adopted), suggested that 'it should be made the duty of the State Commissioner to send to the school inspector of each town a "Lancaster Manual," containing observations on teaching and school government, and thus diffuse throughout the State the latest and most practical information as to approved methods.' In 1832 he was instrumental in securing the distribution of a copy of "Hall's Lectures on School Teaching," to each school district (9,000), and in 1833 recommended the incorporation into the school act of a provision authorizing a majority of the voters 'to raise by a tax on the property of each district $15 or $20 as a commencement of, and $5 or $10 annually, as a perennial spring, to purchase and sustain a school library,' until 1835, when the foundation of the district school library was laid by the passage of an act giving the authority as above suggested. To secure a beginning in this direction, Mr. Wadsworth offered to pay one-fourth of the $20 to all districts in Avon and Geneseo, and then offered $20 to the first five districts in Henrietta which should adopt the same, and employed the Rev. Mr. Page to give lectures on the subject, in all towns of Livingston County, and in other sections. In 1838 he labored to secure the appropriation of a portion of the income of the United States Deposit Fund for the same purpose, and through the exertions of the Hon. G. W. Patterson, who was then Speaker of the House, and the Hon. D. D. Barnard, chairman of the committee, this was accomplished, and $55,000 was annually appropriated for the purpose. To his labors in this direction should be added the publication, at his expense, of *The School and the Schoolmaster*—the first prepared by Prof. Alonzo Porter, and the last by George B. Emerson of Boston, and the distribution of over 15,000 copies, one to each school district, and to town and county school officers. Mr. Wadsworth also paid the expense of the American edition of Cousin's *Report on the School System of Prussia* in 1834, and aided J. Orville Taylor in the publication of the *Common School Advocate* from 1835 to 1838.

The common schools are situated in

11,350 districts, taught in houses which, with their sites, are valued at $23,468,266, accommodating 1,028,147 children in attendance some portion of the year (to which should be added 5,807 in normal schools, 30,370 in academies, 3,194 in colleges, 135,433 in private schools), taught by 28,217 teachers (21,668 females). The average daily attendance of children attending the common schools is placed at 493,648.

The means for the support of schools for the year 1872 were derived from the following sources, viz., The Common School Fund ($3,004,513), $170,000; United States Deposit Fund ($4,414,520), income $165,000; State school tax (1¼ per cent. on the valuation), $2,610,784; by local tax, $6,552,994, making a total of $10,874,910. Among the items of expenditure we find, for the wages of common school teachers, $6,510,164; district school libraries, $30,917; school apparatus, $179,156; colored schools, $678,582; school construction and furniture, $1,982,547; incidental expenses, $1,164,142; appropriation for academies, $44,646; teachers' classes in academies, $15,345; Teachers' Institutes, $16,171; Normal Schools, $128,723; Cornell University, $25,000; Indian schools, $6,837; superintendent of public instruction, $18,127; regents of universities, $6,349; printing registers for school districts, $13,000. To these items should be added the following not included in the aggregate above given: deaf and dumb institution, $103,923; institution for the blind at New York, $39,903; institution for the blind at Batavia, $40,500; state asylum for idiots, $50,000; orphan asylums, $9,000; school commissioners' salaries, $90,187; state reformatory at Elmira, $198,000.

The enormous sums expended for the common schools of New York will be realized in the fact that from 1850, when the school expenditure was $1,607,684, to 1872, when the total expenditure was $9,607,903—a period of 22 years—the aggregate expenditure was nearly $106,146,344.

In 1825, orphans in special asylums were first recognized as entitled to the distribution share of any money appropriated to common schools, which is now made the basis of the special appropriation in their behalf to the amount, in 1871, of $472,760.

In 1866, the superintendent was charged with providing schools for the Indian children, which in 1871 numbered 1,073, in 27 schools, at a cost of $8,559.



The system of common schools rests on territorial subdivisions of the State known as School Districts, whose boundaries are defined and altered by the School Commissioner, and on Union Free School Districts, formed with special powers under the act of 1853, and the City Districts created by special acts.

The officers intrusted with the administration of the system, beginning at the lowest point, are:

1. *District Trustees*—composed of one or three, as the district may decide. The three act as a board, and the sole trustee has the same power as a board of three. These powers and duties are: to call meetings; to make out tax lists and warrants; to purchase sites, and build or hire school-houses; to insure district property; to have the custody and safe keeping of the school-house and other property; to contract with and employ teachers, and pay them; and generally to attend to all the business of the district. They must make in October of every year, a return in form and substance as required by law, to the School Commissioner, as the basis of all school statistics, and such other information as the State Superintendent may from time to time require. There is also a district clerk, collector, and librarian.

2. *Town Clerk for each town*—is required to keep in his office all books, maps, papers, and records touching schools; to record in a book the certificate of apportionment of school moneys; to notify the trustees of the filing of such certificate; to obtain from trustees their annual reports; to furnish the School Commissioner with the names and post-office address of all district officers; to distribute to trustees all books and blanks forwarded to him for their use; to file and record the final accounts of supervisors; to preserve the supervisor's bond; to file and keep the description of district boundaries; and when called upon, to take part in the erection or alteration of a school district. The supervisor for each town receives all moneys destined for school purposes in the town, and disburses according to law and the special direction of the State Superintendent.

3. *School Commissioners*—elected for certain districts originally established by boards of supervisors, but now determined by law to the number of 112 for the State. They have power, and it is their duty, to see that the boundaries of districts are correctly described; to visit and examine the schools; to advise with and counsel the trustees; to look after the condition of the school-houses, and condemn such as are entirely unfit for use; to recommend studies and text-books; to examine and license teachers; to examine charges against teachers, and, on sufficient proof, annul their certificates; and when required by the Superintendent, to take and report testimony in cases of appeal. It is also their duty, annually, to apportion and divide among the districts the school moneys apportioned to their respective counties by the Superintendent of Public Instruction.

4. *Department of Public Instruction.*—The head of this department is the State Superintendent, which office was originally independent, but in 1822 as such, was abolished and its duties assigned to the Secretary of State, who performed them through a special clerk or deputy, until 1854, when it was again separated and instituted into the Department of Public Instruction. The superintendent is elected by joint ballot of Senate and Assembly. He holds

office for three years; has general superintendence of the public schools, visits them, inquires into their management, and advises and directs in regard to their course of instruction and discipline. He apportions and distributes the public moneys appropriated by the State for the support of schools; examines the supplementary apportionments made to all the districts by the School Commissioners, and sees that to each district is set apart its proportionate share, and that the same is expended by the trustees, and paid by the supervisors of towns, according to law. He gives advice and direction to school officers, teachers, and inhabitants upon all questions arising under the school laws. He establishes rules and regulations concerning appeals. He hears and decides all appeals, involving school controversies, that are brought before him, and his decision is final. He is charged with the general control and management of Teachers' Institutes in the several counties of the State; is authorized to employ teachers and lecturers for the institutes, and to pay them, and to certify the accounts for expenses incurred by the commissioners in conducting the same. He is required by the law to visit the institutes, and to advise and to direct concerning their proper management. He establishes rules and regulations concerning district school libraries; he makes appointments of State pupils to the institutions for the instruction of the deaf and dumb and for the blind, upon the certificate of the proper local officers; and he visits and examines into the condition and management of these institutions. He is chairman of the executive committee of the State Normal School at Albany, and apportions among the counties the number of pupils to which each is entitled. He is one of the board for the selection of the places in which to establish any additional Normal Schools. After the schools are established, he has general supervision and direction of them; he appoints the local board to manage them; he approves the rules for their government: he directs the form of their reports; and all payments for their support are paid upon his certificate. He approves the course of study; the number of teachers and their wages are subject to his approval; he can cause one or more of the schools to be composed of males, and one or more of females, in his discretion; and he decides upon the manner in which pupils shall be admitted from the several parts of the State. He has similar powers over the Oswego Normal School, and six similar schools since established. He has charge of all the Indian schools in the State, employs local agents to superintend them, visits them, and directs concerning the erection and repair of their school-houses, and determines the branches of instruction to be pursued in the schools. He is, *ex-officio*, a Regent of the University and chairman of the committee on teachers' classes in academies. He is also, *ex-officio*, a member of the Board of Trustees of the Idiot Asylum, and the Cornell University. He receives and compiles the abstracts of the reports from all the school districts in the State, setting forth their condition and proceedings, and the account of receipts and expenditures for each year. He makes, annually, to the legislature a report of the condition of all the schools and institutions under his supervision, and recommends such measures as, in his judgment, will contribute to their welfare and efficiency.

### NORTH CAROLINA.

North Carolina was first settled in 1653, and in 1720 had on an area of 45,000 square miles a population of 393,751 (100,573 slaves), which in 1870 had increased to 1,071,361 (391,650 colored), with $624,868,971 taxable property.

The first official allusion to the want of schools in North Carolina is believed to have been made by Governor Johnston, a native of Scotland, in his address to the Legislature, in Edenton, in 1736; and the first effectual act for the encouragement of literature was a law passed in 1762, for the erection of a school-house in the town of Newbern. A similar law applicable to the town of Edenton was passed next year.

In 1770, an act for founding, establishing, and endowing Queens College in the town of Charlotte, Mecklenberg County, was repealed by royal proclamation, and its re-enactment in the year following met with the same fate. In 1776 this county, in advance of the Continental Congress at Philadelphia, declared the State forever absolved from allegiance to the British Crown, and in the year following incorporated 'the President and Fellows of *Liberty Hall*, in the County of Mecklenberg,' with the following preamble: 'Whereas, the proper education of youth in this infant community is highly necessary, and would answer the most valuable and beneficial purposes to this State and the good people thereof; and whereas, a very promising experiment hath been made at a seminary in the County of Mecklenberg, and a number of youths there taught have made great advancements in the knowledge of the learned languages, and in the rudiments of the arts and sciences, in the course of a regular and finished education, which they have since completed at various colleges in different parts of America; and whereas, the seminary aforesaid, and the several teachers who have successively taught and presided therein, have hitherto been almost wholly supported by private subscriptions, in order therefore, that said subscriptions and other gratuities may be legally possessed and duly applied, and the said seminary, by the name of Liberty Hall, may become more extensively and generally useful, for the encouragement of liberal knowledge in languages, arts, and sciences, and for diffusing the great advantages of education upon more liberal, easy, and generous terms,' &c.

The institution was born in stormy times, and the enterprise, after the trustees made several ineffectual attempts to get a president from Princeton College, and sufficient funds, was abandoned.

In the State Constitution, framed at Halifax in December, 1776, they provided 'that a school or schools shall be established by the Legislature for the convenient instruction of youth, with such salaries to the maters, *paid by the public*, as may enable them to instruct at low prices; and all useful learning shall be encouraged in one or more universities.' The establishment of public schools was thus expressly enjoined upon the Legislature; and the order in which the public school and the university is mentioned, shows the connection and dependence which the framers of the Constitution thought should exist between them. The language was mandatory,—'schools *shall* be established by the Legislature.' The schools were to be fit, 'convenient,' accessible to all; and the salaries to the masters were to be '*paid by the public*.' They provided, first, in the organic law, for the instruction of the children of the people at the public charge; and secondly, for 'one or more universities,' in which 'all useful learning' should be encouraged. In 1789, the University of North Carolina was established and endowed, but no provision was made for common schools. Speaking of this period, Judge Murphey, in an address in 1827, remarks:

'The number of our literary men has been small when compared with our population; but this is not a matter of surprise when we look on the condition of the State since the close of the Revolutionary War. When the war ended, the people were in poverty, society in disorder, morals and manners almost prostrate. Order was to be restored to society, and energy to the laws, before industry could repair the fortunes of the people; schools were to be established for the education of youth, and congregations formed for preaching the gospel, before the public morals could be amended. Time was required to effect these objects; and the most important of them, the education of youth, was the longest neglected. Before this university went into operation in 1794, there was not more than three schools in the State, in which the rudiments of a classical education could be acquired. The most prominent and useful of these schools was kept by Dr. David Caldwell, of Guilford County. He instituted it shortly after the close of the war, and continued it for more than thirty years. The usefulness of Dr. Caldwell to the literature of North Carolina will never be sufficiently appreciated; but the opportunities of instruction in his school were very limited. There was no library attached to it; his students were supplied with a few of the Greek and Latin classics, Euclid's Elements of Mathematics and Martin's Natural Philosophy. Moral Philosophy was taught from a syllabus of lectures delivered by Dr. Witherspoon in Princeton College. The students had no books on history or miscellaneous literature. There were, indeed, very few in the State, except in the library of lawyers who lived in the commercial towns. I well remember, that after completing my course of studies under Dr. Caldwell, I spent nearly two years without finding any book to read except some old works on theological subjects. At length I accidentally met with Voltaire's history of Charles the Twelfth of Sweden, an odd volume of Smollett's Roderick Random, and an abridgement of Don Quixote. These books gave me a taste for reading, which I had no opportunity of gratifying until I became a student in this university in the year 1876. Few of Dr. Caldwell's students had better opportunities of getting books than myself; and with these slender opportunities of instruction, it is not surprising that so few became eminent in the liberal professions. At this day, when libraries are established in all our towns, when every professional man, and every respectable gentleman has a collection of books, it is difficult to conceive the inconveniences under which young men labored thirty or forty years ago.'

The following extract from the number of the North Carolina Journal for the 22d of June, 1795, seems to present a brighter picture of the advance of public education, but it will be seen that the limited number of academies named, and the great importance attached to the fact that they were able to prepare youths for an entrance into college—itself at that time hardly in advance of the high schools of the present day, denote no very high degree of literary attainments, and would hardly in our times be esteemed worthy of a newspaper article.

'We have the pleasure to announce to the public that the Academy at Thyatira, erected and conducted by Dr. McCorkle; the Warrenton Academy, under the management of the Rev. Mr. George; and the Chatham and Newbern academies, are all in a very flourishing state. The high reputation and great experience of the gentlemen who have the direction of these seminaries will insure their establishment and success, and furnish annually a large number of students prepared to enter at once at the university upon the higher branches.

From 1789 to 1825, though the 'old-field' or English schools were multiplied, and a few academies and high schools were established, no provision was made for common schools. In 1816, Hon. Archibald D. Murphey, of the county of Orange, then a member of the State Senate, made an able and highly interesting report to that body on the subject of public instruction, urging the establishment of common schools, and also of an institution for the deaf and dumb. The report concluded with a resolution authorizing the speakers of the two houses to appoint three persons to digest a system of public instruction, and submit the same to the next General Assembly. The report and resolution were adopted; and subsequently, and it is presumed under this resolution, Duncan Cameron and Peter Browne, Esqrs., and the Rev. Joseph Caldwell, the President of the University, were charged with this duty. The committee never met, but a report was prepared by their chairman, and laid before the Assembly. In 1818, Mr. Murphey made another report, more in detail and more practical.

'In 1825, the Legislature passed the first act on the subject,—'An Act to create a fund for the establishment of common schools.' To Bartlett Yancey, of the county of Caswell, is due the high distinction of having conceived and penned the first act for the establishment and promotion of common schools. This act set apart for the purpose certain stocks, the vacant and unappropriated swamp lands, the tax on auctioneers, retailers of ardent spirits, &c..—'the *parings* of the treasury,' as they were called by Mr. Yancey himself. But the funds accumulated slowly, and the friends of the system went to work by tongue and pen to increase the fund, and thus obtain means for starting the schools. Foremost among these was the Rev. Joseph Caldwell, a scholar, a philosopher, a statesman, and a christian. He wrote, and caused to be published at his own expense, in 1832, a series of 'Letters on Popular Education, addressed to the People of North Carolina;' in which he examined the whole subject with great care, showed the importance of educating *all* the children of the State, and urged the people to instruct their representatives to take early and effectual steps in this, their highest temporal concern.

'In 1836, another act was passed, organizing 'a Board of Literature,'—providing for draining the swamp lands, and still further increasing the school fund. The public mind now began to be generally aroused on the subject; and several able papers, advocating public instruction, were presented to the Legislature in 1838,—one by the president and directors of the literary fund, and one by Mr. W. W. Cherry, of Bertie, being a report of his as chairman of the committee on education. In 1837 the State received on deposit from the General Government, under the deposit act of 1836, the sum of $1,433,757.39, which was invested for the benefit of common schools, and increased the permanent fund to about $1,732,000, exclusive of swamp lands.

In 1838, a bill drawn by Mr. W. W. Cherry, providing for laying off the State into school districts, and for submitting the question of 'school' or 'no school' to the people of the respective counties, was passed. The act embraced the present plan of requiring each county to raise one dollar for every two dollars distributed by the literary board. In 1839 nearly all the counties adopted the system; and in 1841 *it was put into full operation.*

In 1852, C. H. Wiley was appointed State Superintendent, and on the breaking out of the war of secession, in 1861, had inaugurated a system of common schools which was adapted to the social and political habits of the people, but perished in the disturbances which followed.

In the constitution of 1868 it is made the duty of the legislature 'to establish a general and uniform system of public schools, free to all the children of the State between the ages of 6 and 21. In 1869 a system was inaugurated which is yet laboring with the difficulties of a disorganized society—social and industrial, and with details of organization foreign to the general policy and habits of the people. Out of 99,114 persons between 6 and 21 years, 29,303 were estimated to be in 1,398 public schools.

OHIO.

Ohio remained a portion of the territory northwest of the River Ohio, in which the old Congress of the Confederation began in 1787, its beneficent policy of incorporating 'schools and the means of education' among the organic elements of civil society, and laid the foundation of numerous States of imperial dimensions and industrial resources, in impartial freedom, morality, and knowledge, until 1799, when it was organized as a distinct territory, and admitted into the United States in 1802, with an area of 39,964 square miles, and a population in 1800 of 45,365, which had increased in 1870 to 2,665,260, with a taxable property returned to the value of $1,167,731,097.

In the plan of settlement in 1785, the public lands were surveyed into townships of *six miles square*, containing 36 *sections* of one mile square of 640 acres each, one of which was reserved for public schools. The act of Congress passed April 30, 1802, 'to enable the people of the eastern division of the Territory Northwest of the river Ohio, to form a constitution and State government, and for the admission of such State into the union, provides that section numbered 16 in every township, and where such section has been sold, granted, or disposed of, other lands equivalent thereto and most contiguous to the same, shall be granted to the inhabitants of such townships, for the use of schools.' Other special tracts were granted to the State, or reserved from ordinary purchase, were vested in the legislature in trust for schools. The entire land surface of Ohio was 25,576,969 acres, the land grants and reservations for schools amounted to 710,500, exclusive of two townships reserved for a university. In spite of these beneficent provisions, and of the school habits of many of the families among the original settlers, the institution of public schools in a new country, in sparsely populated townships, with scanty resources, where roads and dwellings were of immediate physical necessity, was slow. The constitution of 1802 enjoins that 'religion, morality, and knowledge being essentially necessary to good government and the happiness of mankind, schools and the means of instruction shall forever be encouraged by legislative provision, not inconsistent with the right of conscience.' Notwithstanding repeated and urgent recommendations by successive governors in their annual messages, the visible benefits of such schools as the first settlers from New England established by voluntary subscription for their children, and the labors of a few men like Ephraim Cutter, Caleb Attwater and Nathan Guilford, it was not till 1825 that a general school law was passed. In this, the principles of taxation are recognized, but no efficient plan of supervision and providing good teachers was adopted. In 1831 the teachers and active friends of schools organized an association called the college of teachers, which began in their annual gatherings the work of school agitation. In 1835, the legislature required school returns from the county auditors, and Prof. Calvin E. Stowe, of the Lane Theological Seminary at Cincinnati, who was about to visit Europe, was appointed to report on the elementary school systems of Prussia and other European States, which was made, and printed in 1837, and produced a profound impression, not only in Ohio, but in other States. In 1836, Samuel Lewis, of Cincinnati (a native of Massachusetts) was appointed State Superintendent with a salary of $500. With experience as a public speaker, with much study of the schools of Cincinnati, and a participant in the discussions of the College of Teachers, Mr. Lewis made great pecuniary and personal sacrifices, and entered on the work of official exploration of schools and agitation of educational topics among the people, in the spring of 1837. He found, 'out of Cincinnati there were no public schools worthy of the name, practically open to rich and poor, and nearly half of the organized school districts were without school-houses, and that not one-third of the whole number would be appraised at $50 each.'

Mr. Lewis's report on the deficiencies of public schools in Ohio, and Prof. Stowe's glowing picture of elementary instruction in Prussia, carried triumphantly through the legislature, in spite of bitter opposition, an act, which made the office of superintendent permanent, created a State School Fund, imposed a county tax of two mills for the support of schools, and authorized district taxation for school-houses, required reports from school teachers, and town and county officers, gave incorporated towns and cities a board of education, with power to establish a public school of a higher grade, and provided county examinations for candidates for the office of teacher. This was the beginning of a state system with some elements of vitality and efficiency in its organization. Mr Lewis entered on its administration in

May, 1838, by issuing the *Common School Director*, and announcing his intention to visit every county, and inviting school officers, teachers, and friends of education to meet him, and as editor and lecturer, 'with his office and head-quarters in the saddle,' he did a work for 1838, for practical results, second to that of no other laborer in the educational field, before or since. In 1839, after making a third report, and a special report on a State university for teachers, Mr. Lewis resigned, with health impaired, without a dollar of compensation for three years hard work, his entire salary having been exhausted in travel and other expenses of his office, but with the consciousness that he had increased the number of schools reported from 4,336 to 7,225, and the value of school-houses from $61,890 to $206,445, and had laid the foundations of a system, which in 1872 reported 11,565 school-houses erected at a cost of $17,168,196, which accommodated 694,348 pupils in enrolled attendance, who employed 22,061 teachers, and required the expenditure for the year of $7,150,856.

The system has been wrought up to its present degree of efficiency mainly through the teachers of the State acting through the State Teachers' Association. In no other State have the teachers engineered their own work so successfully as in Ohio; and yet the census of 1870 shows an amount of illiteracy in the population over 10 years old sufficiently alarming, viz., 92,720 who can not read, and 173,172 who can not write.

In January 18, 1843, in Columbus, a plan of school improvement was presented by Henry Barnard of Connecticut, to the Western College of Teachers, and to members of the Legislature—afterwards at Cincinnati and Sandusky—which resulted in the passage of an Act to facilitate the consolidation of school districts, and the organization of Union Schools; the holding of a Teachers' institute at Sandusky; the bringing of Dr. A. D. Lord from Kirtland to become the principal of the High School and Superintendent of Public Schools of Columbus; to the publication of a school journal at the Capital, and a series of measures which led finally to the employment of Lorin P. Andrews, as the agent of the Ohio Teachers' Association. The first Teachers' Institute was held at Sandusky, under the auspices of Chief Justice Lane, at the suggestion of Mr. Barnard, by Hon. Salem Town.

The following items, taken from official documents for 1872, show the magnitude of the educational expenditures of Ohio; State Commissioner, clerks, &c., $5,169; local management and county superintendents, $129,615; school sites, buildings, and equipment, $1,428,964; teachers' wages—primary schools, $3,898,156; teachers' wages—high schools, $321,406; total $4,219,563; contingent expenses, $1,639,214; total for common school purposes, $7,383,856; institution for deaf and dumb, $63,405; institution for blind, $111,816; institution for idiots and feeble minded, $52,722; State home for soldiers' orphans, $114,009; reform farm school for boys, $45,000; industrial school for girls, $26,553.

OREGON.

Oregon was organized a Territory in 1848, and admitted a State in 1859 with an area of 95,274, and a population in 1860 of 52,405, which had increased in 1870 to 90,923, with $31,798,510 of taxable property.

By the constitution of 1857, the governor is made superintendent of public instruction for the term of five years, after which the legislative assembly may provide by law for his successor. The proceeds of all lands granted to the State for educational purposes, except the university land, all money which may accrue to the State by escheat or forfeiture, exemptions from military duty, from the sale of the 500,000 acres reserved by act of 1841, and of the five per centum of net proceeds of the sales of the public lands on the admission of the State into the Union, shall constitute an irreducible fund for the support of common schools in each school district, and the purchase of suitable libraries and apparatus therefor. The school lands amount to 4,475,966 acres.

In the act of 1862, provision is made for the election of a school superintendent for each county, and for three directors for each district.

According to the census of 1870 there were 18,096 persons, out of a school population of 29,400 attending school, and 1,047 persons over 10 years of age who could not read, and 2,064 who could not write. The same census returns 637 schools of all kinds, of which 4 were public high with 502 pupils, 590 common schools with 27,000 pupils, 16 academies with 1,600 pupils, 2 colleges with 298 pupils, 1 school of medicine, 1 agricultural college and 2 commercial schools.

### PENNSYLVANIA.

Pennsylvania was first settled in 1638, and by the first national census of 1790, on an area of 46,000 square miles, had a population of 434,373, which in 1870 had increased to 3,521,790, with taxable property to the value of $1,243,367,852.

The first constitution adopted in 1776 had no provision respecting schools, and that of 1798 enjoined 'the legislature as soon as conveniently may be, to provide by law for the establishment of schools throughout the State, in such manner that the poor shall be taught gratis." In 1838, an attempt in the convention which framed the constitution of that year, to amend this provision so 'as to provide by law for the establishment of common schools throughout the State, in such a manner that all persons residing therein may enjoy the benefits of education,' failed, leaving the provision as in 1798.

The first general school law was passed in 1819, expressly 'to provide for the poor gratis,' in which with minute definition of such as are entitled to the benefit of this act, viz., 'of children between the ages of five and twelve years, whose parents are unable to pay for their schooling, and excluding all children whose education is otherwise provided.' A list of these children, made out by the assessors of each township, corrected by the commissioners of the county, is sent to teachers of schools within the township, with instructions to enter against the names of such children on this list as apply for tuition, the number of days they may attend or be taught, and send in their bill for the same to the county commissioner.

The first act, under which any demonstration of what public schools could become, was special for the city and county of Philadelphia, by which a broad and beneficent system of public instruction has been developed, was adopted in 1818. By this act, in 1871, 414 schools (viz., 1 Boy's Central High School or College, 1 High and Normal School for Girls, 58 Grammar schools, 142 Intermediate schools, 186 primary schools and 26 night schools), with 87,428 scholars, 1,668 teachers (79 male and 1,589 female teachers, supported at a cost of $1,370,705. The valuation of school property in 1872 exceeded $3,000,000.

The first provision for general education for the State was made in 1831, which the supplementary acts of 1834, 1835, 1836 and 1837 has developed into an efficient system of public schools, for which much is due to the wise organization and administration, and the judicious publications of Thomas H. Burrowes of Lancaster, who became the first Superintendent of Public Schools as Secretary of State in 1834. This office was made independent in 1857. County Superintendence were first organized in 1854, and the first State Normal School in 1857. The State Teachers' Association was organized in 1852; the first School Journal was published in 1836, and the Pennsylvania School Journal in 1852; the first Teachers' Institute was held in 1849, and the attendance has increased from 3,704 teachers in 1866 to 11,890 in 1871.

The following items from the Report of the Superintendent (J. P. Wickersham) for 1872, illustrate the magnitude of the operations of the system of common schools: The total expenditure was $8,345,072. This sum supported 15,999 schools in 2,029 cities and towns; paid 18,368 teachers, for 834,313 pupils, in buildings which with their grounds and equipments have an estimated value of $18,689,624; and employed in the district management and county superintendence, 13,541 persons.

To the above expenditures for common schools in cities, villages and rural districts should be added $475,245 paid to thirty-seven institutions (existing asylums mainly under religious denominations) for the support and instruction of 3,527 soldiers' orphans, which has already cost the State $3,467,543; $54,000 for the instruction of the mute, $70,000 for the instruction of the blind; $28,000 for training feeble minded children; $10,000 for friendless children; $71,900 for juvenile offenders; $11,500 for Lincoln University; $25,00 to the University of Pennsylvania.

The following outline of the system of common schools in operation in 1871 is taken mainly from the Report of the Superintendent for that year:

(1,) *Districts and District Officers.*—Each township, borough, and city is made by law a school district. The districts thus formed are the only ones except a small number of what are called 'independent districts,' with a single school, formed out of parts of adjacent counties, otherwise badly accommodated with schools. Outside of cities and boroughs, the school districts have from one to thirty schools, the average number being about seven. The power of levying and collecting taxes, building and furnishing school-houses, employing and paying teachers, selecting text-books, and managing the schools generally, is vested in a board of six directors, two of whom are elected annually at the regular local elections. The courts have power to remove directors for the non-performance of duty, and the State Superintendent can refuse to pay a district its quota of the annual State appropriation, if its directors do not keep the schools 'open according to law.'

(2,) *Superintendents for Towns, Cities, and Counties.*—The directors of a district are authorized by law to appoint and pay a District Superintendent, and to require the Teachers in their employ to hold a District Institute. Each board is compelled to make an annual report to the State Superintendent through the agency of the proper County Superintendent, who must approve it, accompanied by a sworn statement to the effect that the schools of the district have been kept open and in operation according to law, and specifically declaring that no teacher has been employed during the year who did not hold a valid certificate, and that the accounts of the district have been legally settled. Failing to make such a statement works a forfeiture of the State appropriation.

The school directors of each county, and of each city and borough having over 7,000 inhabitants, as may choose to do so, meet in convention triennially, at the call of the State Superintendent, to elect a superintendent and fix his salary. The directors fix the salary of the office absolutely, but they are limited in their choice of a person to fill it, to persons having certain scholastic and professional qualifications, of the sufficiency of which the State Superintendent is to judge before he issues the commission. The State Superintendent pays the salaries of the County Superintendents and fills all vacancies in the office by appointment.

The duties of the superintendents of counties, cities, and boroughs are to examine and certificate teachers, visit schools, give instruction to the teachers, hold institutes, and supervise generally the school interests intrusted to their care. They make monthly and annual reports to the School Department.

(3,) *Teachers and their Certificates.*—No person can be employed to teach in a common school who does not hold a legal certificate in one of the forms which are granted as follows:

A provisional certificate, which is a mere license to begin to teach. It is good only in the county where issued, and for a single year. A scale of figures from one to five is used in filling up this certificate, to denote degrees of proficiency in the several branches.

A professional certificate, which is a license to teach in the county where issued for the term of the Superintendent granting it, and for one year thereafter. It is granted to any good teacher who can pass an examination in orthography, reading, writing, arithmetic, geography, grammar, history of the United States, and the theory of teaching.

A permanent certificate, which is granted by this department to teachers holding professional certificates, whose application therefor is indorsed by the proper superintendent, the proper board or boards of directors, and by a county committee of teachers elected by ballot for this purpose at the Teachers' Institute. This certificate is good permanently in the county where issued, and for one year in any other county.

A State certificate, which is issued to teachers who pass an examination, in a prescribed course, before the Board of Examiners of the State Normal Schools. This certificate is permanently good in any part of the State.

(4,) *State Normal Schools.*—The State is divided into twelve Normal School districts. To nine of these the State has appropriated $15,000 each towards the erection of buildings for Normal School purposes. The balance of the money required for their erection either has been or must be raised by local contributions. The buildings when erected do not belong to the State, but to the stockholders or contributors, who, however, can not dispose of them or use them for any other purpose, without the consent of the State authorities. The State has appropriated considerable money to the several schools for the purchase of apparatus. No school can be recognized as a State Normal School until it has been found by the State authorities to conform to the requirements of law, and, when recognized, its charges, course of study, and disciplinary regulations must be approved by the State Superintendent. The State furnishes diplomas for all graduates of Normal Schools, and the State Superintendent is chairman of the board that conducts the examination of the graduating classes. The State pays each student, who is attending a Normal School for the purpose of becoming a teacher, fifty cents a week towards his expenses, and gives him a gratuity of fifty dollars at graduation. All appropriations to State Normal Schools are paid by the State Superintendent. A diploma of the first degree, given at a State Normal School, exempts the holder from examination in any part of the State for a term of two years after graduation; but at the expiration of that time he must either submit to an examination, or present to the Board of Examiners of the Normal School where he graduated, an application for a diploma of the second degree, indorsed by the board or boards of directors for whom he has taught, and by the proper superintendent. This, if granted, makes him a teacher for life.

(5,) *State School Department.*—This department consists of the State Superintendent, who is appointed by the Governor, with the consent of the Senate, and holds his office for three years, and appoints his subordinate officers, which consisted in 1871 of a deputy superintendent, two inspectors of Soldiers' Orphan Schools, four clerks, and a messenger. The work of the School Department, with respect to the several educational agencies of the State, is briefly as follows:

With respect to *Teachers*:—It prepares and furnishes certificates for all the eighteen thousand teachers, and grants directly certificates to such of them as have reached the higher grades of the profession.

With respect to *School Directors* and *Comptrollers:*—It gives advice and instruction concerning their duties to the thirteen thousand school directors and comptrollers, furnishes them blanks, receives and tabulates their reports, reviews their accounts, judges whether they have kept their schools open according to law, and if so, pays them the State appropriation for their respective districts.

With respect to *County Superintendents*:—It calls conventions for the election of County Superintendents in the several counties, receives the returns and judges of their legality, commissions the persons elected, removes the disqualified, pays their salaries, provides blanks for recording and tabulating their work, and receives and publishes their reports.

With respect to *City* and *Borough Superintendents:*—It holds about the same relation to the City and Borough Superintendents as it does to County Superintendents, except in the matter of the direct payment of salaries.

With respect to *Teachers' Institutes:*—It furnishes the Teachers' Institutes—one being held in each county—with blanks for reports; receives, tabulates, and publishes their reports, and renders all the assistance possible in their management.

With respect to *State Normal Schools:*—It investigates the claims of Normal Schools to State recognition, executes all legal forms necessary to their becoming State institutions, examines and approves their courses of study, their governmental regulations and their charges to students, visits them, appoints the times of examining their graduating classes, and assists at the examinations; furnishes diplomas for their graduates, receives and publishes their reports, and pays them their State appropriations.

With respect to the *Soldiers' Orphan Schools:*—It has almost complete control of the forty different institutions in which soldiers' orphans (3,600) are maintained and instructed; the accommodations, the persons employed, the food, clothing, instruction, and discipline of the children being subject to the direction of the State Superintendent.

With respect to *Colleges* and *Academies:*—It receives, tabulates, and publishes all reports made by colleges and academies, as required by law.

Besides all this, the department makes an annual report to the legislature, containing full information concerning the condition of the system of public instruction in the State, and proposing plans for its improvement; to give advice appertaining to their school interests to every citizen who asks it, and to decide all questions relating to those interests, without expense to the parties presenting them.

To carry out, with the necessary system, the multiplied details of this immense work, the department prepares and issues, to the different school agencies and officers throughout the State, some thirty-five kinds of blank-books and forms, and is compelled to use twenty-five kinds of blank-books in which to keep its own records. Its correspondence reaches full fifteen thousand letters per annum.

With all the expenditures by the State and municipalities, and with all the activity and coöperation of school officers and the people, the statistics of adult illiteracy and non-attendancce of children of school age are truly formidable and alarming. The national census of 1870, returns 131,728 persons, ten years and over, who can not read, and 222,536 who can not write, and of the latter, 126,803 are natives. The Superintendent in his report for 1872 remarks: 'It is to be feared that the number of illiterates, both of youth (31,512 between the ages of 10 and 21 years) and those of mature age (190,829), is much below the actual number. The number reported should be doubled, and more than doubled, who are growing up in ignorance.

### RHODE ISLAND.

Rhode Island was first settled in 1631, and in 1790 had a population of 69,122, which in 1870 had increased to 217,353, with an area of 1,306 square miles, and a valuation of $213,570,350 taxable property.

Under the settled policy of its founders during the colonial period of its history, the people tolerated no legislative interference with religious belief or practice, or with the education of children, which, like religion, was considered strictly a parental and individual duty. In some towns, donations in lands were made by individuals for the support of Free Schools—the endowed grammar schools of England. Soon after the adoption of the federal constitution, the subject of public schools was agitated in the pulpits; and in 1798 a committee of the Providence Association of Mechanics and Manufacturers appointed a committee 'to inquire into the most desirable method for the establishment of free schools.' On the recommendation of this committee, a memorial and petition drawn up by John Howland, of Providence, was presented to the General Assembly, and in 1800 'an Act to establish Free Schools' was passed, but which met with violent opposition, and was repealed in 1803, before any town but Providence had acted on its provisions. That town was excepted in the repeal. In 1825 the town of Newport was authorized to raise money by tax for the support of a free school, and to apply to it the avails of certain lands which had been bequeathed to the town for this purpose.

In 1828, after many years of agitation 'an act to establish public schools' was passed, by which 'all money paid into the general treasury by managers of lotteries or their agents, by auctioneers for duties accruing to the State, &c.,' was set apart for the exclusive purpose of keeping public schools. Each town was empowered to raise money by tax not exceeding in any one year twice the amount received from the State (which was by law not to exceed $10,000 in any one year), provided special notice was inserted in the warrant for the town meeting that such a tax would be acted on,' and such towns could appoint a school committee to manage the schools set up under this act. The town of Providence was authorized by special law to assess and collect any amount of tax for free schools, and in 1836 took the necessary steps to put the public schools on a basis of organization, and with an outfit of school-houses, and material appliances, and with a superintendent (Nathan Bishop, the first city superintendent of public schools in the United States), and a corps of well qualified teachers for each grade of school from the primary to the high (for both sexes), which in five years placed its system of public instruction in advance of all other cities in the country.

Under this act (of 1828), supplemented by special acts from year to year to enable a few districts to build school-houses by tax, and a revision of the law in 1839, by which the annual State appropriation was increased to $25,000, and the power of the towns to raise money by tax was extended to double the sum received from the State, and by six acts 'in addition to and amendments thereof' down to 1843, feeble and altogether unsatisfactory beginnings were made to establish public schools. In 1843, Wilkins Updike, a member of the House from South Kingston, introduced a bill for a public act (drawn up by Henry Barnard of Connecticut), 'for ascertaining the condition of the public schools in this State, and for the improvement and better management thereof.' The bill simply provided for the appointment of an agent 'to visit and examine the public schools, the qualifications of teachers, and their mode of instruction, and the actual condition and efficiency of the schools and popular education generally, and make report to the legislature, with such plan as his observations and experience may suggest.' The bill was explained by Mr. Updike, and in the evening before a convention of the two houses, by Mr. Barnard, who had then just returned from a tour of observation and pioneer work into every State in the Union, and on the following morning it became a law without a dissenting voice; and before Mr. Barnard could leave the town the governor had issued a commission appointing him to the office created by the act. The position was at once respectfully and firmly declined; but on the urgent solicitation of Mr. Updike, Hon. E. R. Potter, Dr. Wayland, Mr. Kingsbury, and public men of both political parties, (and the State was widely and bitterly divided by the 'Dorr War' and the two constitutions), Mr. Barnard reconsidered his decision, and on the 5th of December entered on his work of school inspection and educational conference and agitation in Rhode Island. A citizen of another State, in a State proverbially jealous of any interference from abroad in her domestic institutions, and constitutionally opposed to all State interference in matters which belong to the towns, and going among men and into families boastful of their individual liberty to do as they pleased in matters of religion and education, and suspicious of all 'college learnt men,' the agent needed all the coöperation solicited by Governor Fenner in announcing his appointment to the people of Rhode Island.

In pursuance of an act 'to provide for ascertaining the condition of the public schools of this State, and for the improvement and better management thereof,' I have secured the services of Henry Barnard, who has had several years experience in the discharge of similar duties in a neighboring State, and has observed the working of various systems of public instruction in this country and in Europe. Mr. Barnard will enter immediately on the duties of his office. His great object will be to collect and disseminate in every practicable way information respecting existing defects and desirable improvements in the organization and administration of our school system, and to awaken, enlighten, and elevate public sentiment, in relation to the whole subject of popular education. With this view, he will visit all parts of the State, and ascertain, by personal inspection, and inquiries of teachers, school committees, and others, the actual condition of the schools, with their various and deeply interesting statistical details. He will meet, in every town, if practicable, such persons as are disposed to assemble together, for the purpose of stating facts, views, and opinions, on the condition and improvement of the schools, and the more complete and thorough education of the people. He will invite oral and written communications from teachers, school committees, and all others interested in the subject, respecting their plans and suggestions for advancing the intellectual and moral improvement of the rising, and all future generations, in the State. The results of his labors and inquiries, will be communicated in a report to the General Assembly. In the prosecution of labors so delicate, difficult, and extensive, Mr. Barnard will need the sympathy and coöperation of every citizen of the State. With the most cordial approval of the object of the legislature, and entire confidence in the ability, experience, and zeal of the gentleman whom I have selected to carry it out, I commend both to the encouragement and aid of all who love the State, and would promote her true and durable good, however discordant their opinions may be on other subjects.

The plan of operations was to acertain by personal inspection and official reports the actual condition of the schools, and arouse and enlist the people in the thorough and entire change not only of opinion, but of habits in regard to schools and education.

To effect this change, in the course of three years, eleven hundred school meetings were held in the thirty-three different towns—one at least, in every large neighborhood. One hundred and fifty of these meetings were continued through the day and evening; one hundred through two evenings and a day; fifty through two days and three evenings; and twelve as teachers' meetings through the week.

In addition to these meetings and addresses, having reference mainly to legal organization and administration, upward of two hundred meetings of teachers and parents were held for lectures and discussion on the best methods of teaching the studies ordinarily pursued in common schools, and for public exhibitions and examinations of schools or of classes of pupils in certain branches or studies, such as arithmetic, reading, etc. Besides these formal meetings, experienced teachers were employed to visit particular towns and sections of the State which were known to be particularly indifferent or opposed to public schools, and converse freely with parents by the way-side and by the fireside on the condition and importance of these schools. By means of these agencies a public meeting was held within three miles of every home in Rhode Island, and it was believed that three or more members of every family in the State was directly reached and favorably impressed in regard to the educational movement inaugurated in 1843.

To confirm the work begun by the living voice, the printed page was freely resorted to. Besides hundreds of volumes of elaborate treatises, 100,000 pamphlets and tracts, containing at least sixteen pages of educational matter each, were distributed gratuitously throughout the State; and in one year not an almanac was sold in Rhode Island without at least sixteen pages of educational reading attached, including numerous wood cuts devoted to schools as they were, and as as they should be. Upward of 1,200 volumes on schools and school systems and the theory and practice of teaching were purchased by teachers, or added to public and private libraries; and at least thirty volumes of educational literature were placed within the reach of the school committees of each town, and made accessible to teachers.

With this preparation of the public mind, a bill for the modification of the school system was introduced into the Legislature, and its various provisions explained by the agent to the members. After undergoing various changes in that body, the bill was printed with remarks explanatory of the general scope as well as of the minute details, and distributed broadcast over the State; and not until the subject had been repeatedly discussed before the legislature and the people, was any attempt made to press final action, so that when it did become a law in 1855, it was thoroughly understood and went at once into operation without friction or serious opposition, and no attempt was made to weaken its most efficient provisions. To facilitate its introduction, forms of proceeding from the first organization of the school district to laying and collecting taxes, specimen of school registers, district and town school returns, regulations as to classification, studies, books, examination of teachers and schools, were attached and distributed to every school officer.

To facilitate the construction of spacious, attractive and convenient school-houses, the importance of these structures and equipment, their seating, ventilation and heating, was fully explained to parents and school officers, plans were widely distributed, and every coöperation desired by builders or committees was given by the State Commissioner, so that within five years, a complete revolution passed over this department of the field, and no State in the Union was so well furnished with commodious and healthful structures for school purposes.

To keep teachers up to their work, institutes, conventions, associations (State, county and town) were resorted to, a monthly educational journal was published, and treatises on methods and discipline were brought within their reach for purchase or perusal. When the agent closed his work in 1849, in place of unregulated, antagonistic, insufficient in number, and poorly equipped private schools, a system of public instruction was in quiet operation in every town, reaching every neighborhood, taught by teachers of ascertained qualifications, supported by tax, and visited by intelligent and interested school officers.

One of the most effective agencies in this reformatory movement, in enlisting teachers, parents and school offiers in a system of common efforts was the Rhode Island Institute of Instruction, established in 1844, and which in 1873 held its twenty-ninth anniversary in a series of meetings, in the largest public hall in Providence, with a crowded attendance of teachers and school officers, from all sections of the State.

Evening schools, which proved an assential feature of the plan of supplementary instruction in 1845, was taken up systematically in 1867 by Mr. Samuel Austin, through whose activity the Rhode Island Educational Union was instituted, and whose untiring agent he has been since, as well as a worker in this field all his life. In twenty towns in 1872, sixty evening schools have been maintained, with an average of one hundred pupils. The legislature in 1871 made a special appropriation in aid of these efforts, and several towns, as well as many mill proprietors and corporations now regard these schools, with their reading-rooms, lectures, and other facilities of instruction, as essential to the moral and intellectual well-being of manufacturing communities.

The school authorities are: (1,) Board of Education, which is not merely advisory, but has the immediate charge of the State Normal School, and the expenditure of such sums as the Legislature may appropriate ($3,000 in 1871) for evening schools; (2,) State Commissioner of Common Schools, with the usual duties; (3,) Town School Committee—elected for three years with the appointment of a superintendent for each town and city—membership to this committee is open to men and women; (4,) district officers, who employ teachers.

The support of common schools is derived from: (1,) The State treasury—$90,000 in 1872, derived from income of State School Fund ($250,000) and general tax; (2,) Town treasury—$309,578 town tax, and $24,490 registry tax; (3,) District treasuries—$59,722 district taxation.

The number of towns and cities (36) are divided into 423 districts, in which were kept 682 summer schools, attended by 26,912 pupils, and 719 winter schools attended by 28,702 pupils—612 female and 93 male teachers in the summer, and 579 female and 177 male teachers in the winter. The average attendance in public and private schools (8,000) was 38,000 out of 42,000 between the age of five and fifteen years.

The national census of 1870 returns 15,416 persons, ten years and over, who can not read, and 21,821 who can not write. The State board recommend an act to enforce attendance upon some school, public or private, of all children of school age.

### SOUTH CAROLINA.

South Carolina, when first settled in 1670, was organized 'as the County of Carteret in Carolina,' and was constituted a separate royal government in 1727. The first State constitution was framed in 1776, and the population in 1790, on an area of 34,800 square miles, was 249,073 (107,094 slaves), which had increased in 1870 to 705,606 (415,814 colored), with taxable property to the value of $183,913,337.

The earliest efforts to establish schools in the State was at Charleston in 1710, and was confined to the English model of a *free* school, an endowed school, 'with a teacher to teach the Latin and Greek languages.' Similar 'free schools' were instituted in other parishes, 'for instruction in grammar and other sciences,' and provision was made in several instances 'for an usher to teach writing, arithmetic, accounts, surveying, navigation and practical mathematics.' The constitution of 1779, and the revision of 1785, 1798 and 1839 are silent in respect to schools and education. The policy of the State was to leave elementary education to parents, and of the poor in particular, to private and parochial efforts, and to associations, such as the Hibernian, the German, and other national societies. In 1811 the State instituted a fund, the income of which was to secure to every citizen the benefits of education, but in the act itself was the secret of its own failure, a provision that 'if the fund should prove inadequate for all applicants, preference should be given to the poor.' The fund originally provided was small, and was entirely absorbed by the preferred class. The rich were excluded, and the schools, so far as they were independent institutions, degenerated into pauper schools. No one who could help it, would accept an education which could only be granted as a charity, or a declaration of pauperism. The same experiment had been tried in Pennsylvania and in the city of New York, as well as in Virginia. The evil was not remedied by increasing the appropriation, the confession of pauperism was still required. In 1843, and again in 1846, and subsequently by correspondence in this and all the adjoining States, Mr. Barnard of Connecticut, at the request of Gov. Allston, Mr. McCarter and others, 'set forth the practical working of public schools, resting on the basis of all other public institutions, avowedly open to all classes and actually resorted to by the children of the rich and poor, and having all the conditions of a good school in school-houses, classification as to studies, teachers of tested qualifications, and intelligent and constant inspection. With these conditions, the success of public schools in Nashville and New Orleans, demonstrated that these institutions could succeed in Charleston and all other large cities and villages at the South, as well as in New England; and without these conditions, they never had or would succeed any where, no matter by what name they were called—common, free, or elementary. The public school in this country and in this age of the world, must have those elements which make a good school, or parents who know what a good education is, and desire it for their children, will have nothing to do with it. If it is the best school of its grade, the majority of parents will send, while there will always be families in every community who will prefer, from conditions of health, or aptitudes, or other causes, to send their children to private schools.'

In 1854 the initiatory steps were taken—and on the 4th of July, 1856, under the lead of the Hon. C. C. Memminger and Jefferson Bennett, a common school was opened in Charleston, which revolutionized public sentiment in that city, and was fast doing it for the whole State, when the mad passions of men consummated another revolution, which for the time shut up schools of every kind and grade. But before 1861, two public schools existed in Charleston, one embracing the usual classes and grades below a high school, and the other a high school for girls, and a normal school for female teachers for the whole State, were in operation under teachers who had held similar positions in Hartford and Boston, which would compare favorably in all the requisites of good schools—structures and equipment, regularity of attendance, classification by attainments, range of studies, teachers—male and female, of high personal character, intelligent and constant inspection, and the atmosphere of public appreciation. A demonstration more complete of Mr. Barnard's doctrine could not be made, and every credit belongs especially to Mr. Memminger for his constant, judicious and personal labors in inaugurating and consummating the work.

In the constitution of 1868, provision is made for the appointment of a State Superintendent, as had been recommended by Gov. Manning in 1853, and for the establishment of 'a liberal and uniform system of free public schools throughout the State, one of which shall be kept open at least six months in each year in each school district.' The general assembly must also 'provide for the compulsory attendance, at either public or private schools, of all children between the ages of six and sixteen years not physically disabled, for a term equivalent to twenty-five weeks;' a saving clause is added 'that no law to the effect shall be passed until a system of public schools has been thoroughly and completely organized, and facilities afforded to all the inhabitants of the State for a free education of their children.' When to this provision we add another clause, that 'the state normal school, the agricultural college, and all public schools, colleges and universities supported in whole or in part by the public funds, shall be free and open to all the children and youth of the State, without regard to race or color,' it is pretty certain that the law of compulsory attendance is not likely to be passed in this generation, and if passed will remain inoperative on the statute book.

In 1868 the educational department of the State was organized and a Superintendent appointed, but up to 1871, this officer could report only meagre statistical returns. In 1870, a general system was organized and appropriations and taxation made for its support—$37,500 for the university at Columbia, $10,000 for the blind and deaf mutes, $15,000 for the State orphan asylum, $150,000 for free common schools, besides $50,000 from the capitation tax. These are large amounts, and under favorable conditions as to public opinion, and a concentration of population in villages, great immediate results might be anticipated. The law provides for the usual county and district officers, and it remains to be seen if the slow process of school habits can be fostered by their judicious action, and if time will soften the asperities engendered by civil strife and social revolution.

In 1840, the national census returned 20,615 white persons over 20 years of age who could not read and write; and in 1870, according to the same authority, there were 265,892 persons over 10 years of age who could not read, and 280,370 could not write, and out of a school population of 233,915 between the ages of 5 and 18, there was a school attendance of only 38,249.

### TENNESSEE.

Tennessee was originally settled in 1765 from North Carolina, of which it remained an integral portion till 1796, when it was ceded to the United States and admitted into the Union with an area of 45,600 square miles, and a population in 1790 of 35,798, which had increased in 1870 to 1,268,520 (322,338 colored), and taxable property to the value of $254,673,792.

The laws and constitution (1776) of North Carolina extended over Tennessee till 1796, and after that time the only legislation respecting schools was in 1785, to incorporate Davidson Academy at Nashville and Martin Academy in Washington county, and in 1794, Blount College at Knoxville, and Greenville College in Green county.

The constitution of 1796, as amended in 1835, enjoins on the general assembly 'to cherish literature and science,' 'knowledge, learning, and virtue being essential to the preservation of republican institutions,' and to preserve inviolate the funds realized out of land and other appropriations for the support of common schools.

Down to 1825, the educational legislation of the State was confined to incorporating colleges and academies; and by the act of 1817, 'all academies were considered as schools preparatory to the introduction of students into the colleges of this state.'

In 1823, the first provision for public schools was made by devoting certain lands 'to a perpetual and exclusive fund for the establishment and promotion of common schools in each and every county in the state.' In 1827, certain other sources of revenue were added, and the whole was designed to be protected by the constitutional provision of 1835, but proved ineffectual against the executive and legislative necessities in the early stages of the war of secession, at which time the fund had accumulated to the sum of $1,500,000.

In 1867, a new system was inaugurated, but in the political revulsion which followed, its efficient features were stricken out, and the State is now trying to see how a vigorous administration can be established without authority in the law, or will in the hearts of the people, while the astounding fact in the census of 1870 confronts the statesmen of Tennessee that 290,549 persons over 10 years of age can not read, and 364,697 can not write.

In 1873, the legislature reconsecrated the permanent school fund (estimated to be $2,112,000) to its original purpose, and appropriated the income (at six per cent.), and the avails of a capitation tax of one dollar, and a property tax of one mill on the State valuation, to public schools. Provision is also made for a State superintendent, county superintendent, one for each county, and three directors for each district.

### TEXAS.

Texas was settled in 1792, and admitted as a State in 1845, with an area of 237,321 square miles, and a population in 1850 of 212,592, which had increased in 1870 to 808,579 (253,475 colored) and taxable property to the value of $149,734,929.

In the constitution of 1845 it is made the duty of the legislature to make suitable provision for the support and maintenance of public schools, and as early as possible to establish a system of free schools throughout the State. It creates a school fund out of all funds, lands, and other property before set apart for the support of schools, including the alternate sections of land reserved by the State for railroad purposes, and of any other lands which may be derived from the United States government, and also empowers the legislature to levy a tax for educational purposes from year to year throughout the State, and reserves all sums arising from taxes collected from 'Africans, or persons of African descent,' for the exclusive maintenance of a system of public schools for the children of such Africans among whom public schools may be encouraged. It further authorizes the appointment of a superintendent of public instruction. But with all this wise constitutional enactment no efficient law was put on the statute book down to 1862, when the war disorganized society still more, and the census of 1870 showed 189,423 persons over 10 years who could not read, and 221,703 who could not write. By the constitution of 1869, and the school law of April, 1871, school officers were created with all the machinery for administration, but the great work of awakening parental interest, and creating a public opinion has not yet been attempted.

The first report of the State Superintendent for 1871 is devoted mainly to an exposition of difficulties in organizing a compulsory system over a vast area, with a sparse population, and without the inheritance of good school habits. The only encouraging feature is the existence of a permanent School Fund to the value of $2,267,971, yielding $136,096 August 31, 1871.

VERMONT.

Vermont was settled in 1724 largely from the State of Connecticut, and was admitted as one of the United States in 1791, with an area of 10,212 square miles, and a population in 1790 of 85,416, which had increased in 1871 to 330,551, and a valuation for taxable purposes of $102,548,528.

The constitution of 1793 declares that 'a competent number of schools should be maintained in each town for the instruction of youths, and that one or more grammar schools should be incorporated and supported in each county in this State.' Prior to this date, schools had been maintained in each neighborhood, and by a general law passed in 1782, provision was made for the division of towns into convenient school districts, and the appointment of trustees in each town for the general superintendence of the schools, to whom was committed the power of raising one-half of the money required to build school-houses and support the schools by a tax on the grand list, and the other half, either on the list or the pupils of the schools, as the districts might order.

In 1825, the State made provision for a State School Fund, to be reserved until the capital should yield an income sufficient to keep a free common school in each district for a period of two months, but after the lapse of twenty years the accumulations seemed so slow and the necessities of the State requiring a State House, the law was repealed, and the capital, amounting at that time to $250,000, was borrowed and converted into a granite structure; and the schools were kept open quite as long each year in the old ways, which according to the census of 1840 had reduced the amount of illiterary relatively below that of every State but one in the Union. In 1837, the share of the United States surplus revenue deposited with Vermont was distributed among the several towns, and the annual interest ($40,000) to be divided in the same manner as a three per cent. assessment on the grand list for the support of schools in the same.

In 1845, a State Superintendent (Gov. Eaton) was appointed, and teachers institutes were held for the first time under his auspices in 1846. Since 1856, State supervision has been exercised by a Board of Education, acting through a secretary; and town supervision has been administered by a single officer. In 1870, the town superintendents in each county were required to meet the secretary at such place and time (in March or April) each year as he may designate, to agree on a uniform standard of examination for all candidates for positions as teachers, make preliminary arrangements for the annual session of the institute for the county, and confer generally on the interests of education. Each town superintendent must hold two public examinations of candidates, and the State Superintendent must do the same at the county institutes.

In 1866, State Normal Schools were instituted, of which there are now three, at Randolph, Johnson, and Castleton, to each of which $1,000 is appropriated.

The report of the secretary (John M. French) for 1872, is a document of 566 pages—full and instructive as to the condition of the schools, and the difficulties of getting the old district system on to the higher plane of a true system of graded schools. Towns are now (since 1870) authorized to abolish the district system, and place all the public schools under the management of six directors, one-third elected each year for a term of three years. This board may provide for the instruction of all the scholars of the town, in all the branches, higher as well as elementary, of a thorough education, in a series of schools, located for the convenience of families, and adapted to the different stages of advancement of groups of pupils, under teachers best qualified for each stage. Towns are also authorized to establish central schools for the advanced pupils of all the districts.

The following are among the statistical items for 1871–2: Towns and cities, 250; organized school districts, 2,160; fractional districts, 464; families, 67,162; families without children of school age, 46,018; children between five and twenty, 84,946; children attending common schools, 70,904; children attending academies, etc., 4,913; common schools, 2,503; male teachers, 671; female teachers, 3,544; teachers without experience, 861; teachers teaching in same district, 939; teachers, State Normal graduates, 377; teachers who board round, 1,313; school-houses, 3,399, and estimated value of same, $1,265,387; wages and board of teachers, $397,165; amount distributed by State, $116,678; amount raised by town tax, $69,380; amount by district tax, $346,-051; total, $526,000. Census of 1870 returned 15,185 persons over 10 years of age could not read, and 17,706 could not write.

### VIRGINIA.

Virginia was first settled in 1607, and adopted its first constitution in 1776, having in 1790 a population of 748,308 (293,427 slaves). Its original area of 61,352 square miles was reduced by the separation and organization of a portion of its territory into a new State called West Virginia to 38,350 square miles, with a population in 1870 of 1,225,163 (512,841 colored), and taxable property to the value of $365,439,917. The constitution of 1776 contained no reference to education, but in a bill for the more general diffusion of knowledge prepared by Wythe and Jefferson in 1779, there is the following preamble:

Whereas it appeareth that however certain forms of government are better calculated than others to protect individuals in the free exercise of their natural rights, and are at the same time themselves better guarded against degeneracy, yet experience hath shown, that even under the best forms those intrusted with power have in time, and by slow operations, perverted it into tyranny; and it is believed the most effectual means of preventing this would be to illuminate, as far as practicable, the minds of the people at large, and more especially thereby of the experience of other ages and countries, they may be enabled to know ambition under all its shapes, and prompt to exert their natural powers to defeat its purposes; and whereas it is generally true that the people will be happiest whose laws are best, and are best administered, and that laws will be wisely formed and honestly administered in proportion as those who form and administer them are wise and honest; whence it becomes expedient for promoting the public happiness, that those persons whom nature hath endowed with genius and virtue should be rendered, by liberal education, worthy to receive, and able to guard the sacred deposit of the rights and liberties of their fellow-citizens, and that they should be called to the charge without regard to wealth, birth, or other accidental condition or circumstance. But the indigence of the greater number, disabling them from so educating at their own expense those of their children whom nature hath fitly formed and disposed to become useful instruments of the public, it is better that such should be sought for and educated at the common expense of all, than that the happiness of all should be confided to the weak or wicked.

The admirable code of which the above is the preamble, was not adopted, and the first general school law was passed in 1796, with the following preamble:

Whereas it appeareth that the great advantages which civilized and polished nations enjoy, beyond the savage and barbarous nations of the world, are principally derived from the invention and use of letters, by means whereof the knowledge and experience of past ages are recorded and transmitted, so that man, availing himself in succession of the accumulated wisdom and discoveries of his predecessors, is enabled more successfully to pursue and improve not only those arts which contribute to the support, convenience, and ornament of life, but those also which tend to illumine and ennoble his understanding and his nature.

And whereas, upon a review of the history of mankind, it seemeth that however favorable republican government, founded on the principles of equal liberty, justice, and order, may be to human happiness, no real stability or lasting permanency thereof can be rationally hoped for if the minds of the citizens be not rendered liberal and humane, and be not fully impressed with the importance of those principles from whence these blessings proceed; with a view therefore to lay the first foundations of a system of education which may tend to produce those desirable purposes.

In 1810 the Literary Fund was instituted, and in 1816 the directors were instructed to report to the General Assembly a system of public education to comprehend a university, and such additional colleges, academies, and schools as shall diffuse the benefits of education throughout the commonwealth. The report embodied a scheme similar in its main features to that of 1779, which passed the House but was lost in the Senate. In 1818 an act was passed which appropriated $45,000 of the revenue to the primary education of the poor, and $15,000 a year to endow and support a university, to be styled '*The University of Virginia*.'

On the basis of this law, and a special act of 1819, Mr. Jefferson was successful in establishing an institution of higher learning, which educated, down to 1870, 8,000 students for Virginia, and exerted a powerful influence on the organization, studies and discipline of American colleges generally.

The system of primary education on the basis of the Literary Fund in 1811, and the act of 1818, did not accomplish even its narrow and ill-aimed object, the primary instruction of the poor. Governor Campbell, in 1839 proclaimed its failure, and that the utter ignorance of the white adults in that year was greater than in 1817, as evidenced by the register of marriage licenses; and this statement was confirmed by the national census of 1840, which returned 58,787 persons over twenty years of age, out of the free white population, who could not read and write. Well might Governor McDowell say to the Legislature in 1843: 'This plan of common education, which reaches only 28,000 out of the 51,000 poor children, and gives them only sixty days tuition, is a costly and delusive nullity, which ought to be abolished, and another and better one established in its place.' Various plans of modification and substitution was suggested and discussed, but they were set aside in the frenzy of political excitement; and the national census of 1870 returns the illiteracy of the poor whites, with the frightful addition of the entire colored population, over ten years of age, at 390,913, who could not read, and 445,893 who could not write—and of the latter number, 444,623 were natives.

The constitution of 1867, ordains the outline of a system, which if it can be accepted cordially by the people, and administered firmly, but kindly, by officers who have their confidence, will in one generation do more for popular education than has been realized since Rev. Mr. Copeland, in 1621, first moved for the establishment of a 'Free School' in the Colony of Virginia, twenty-six years before 'Brother Purmont was entreated to become schoolmaster for the teaching and nurturing of children' in Boston.

Under the constitution of 1867, and the school law of 1870, a new system is now being administered by W. H. Ruffner, whose second annual report, dated Nov. 1, 1872, is an admirable document, in two parts. Part I. is devoted to a statistical and expository record of the work; Part II. is an exposition of the general principles and methods of the system and institutions established by the earlier and later legislation of Virginia. Both documents should have a wide circulation and find thoughtful readers, and henceforth many 'doers of the word.' The results of 1872, compared with those of 1871, and especially with any year of the former system are very encouraging; 3,695 public schools, with 166,337 pupils, under 3,853 teachers, examined and visited by 91 city and county superintendents, and maintained at an expense of $993,318, is a hopeful exhibition of two years work under such difficulties as exist in this as in the other Southern States. To this number of public schools should be added 856 private schools (648 primary, 187 academies, and 21 colleges), with 20,497 pupils.

In the statistical summary of the Superintendent, and Auditor's Report, appear the following items: Capital of Literary Fund, $1,596,069; pay of public school teachers and treasurers, $643,066; county superintendents, $45,295; central office, $6,490; district expenses, $289,467; University of Virginia, $15,000; Virginia Military Institute, $15,000; Deaf, Mute, and Blind School, $40,000. Aid ($28,900) from the Peabody Fund was given to three Normal Schools, &c.

WEST VIRGINIA.

West Virginia was detached from the territory of 'Old Virginia,' the people refusing to be put out of the United States by the war of secession, and was admitted as a State in December, 1862, with an area of 23,000 square miles and a population in 1860 of 393,224, which had increased to 442,014 in 1870, with taxable property to the amount of $140,538,273.

The Constitution, as amended in 1863, creates a school fund out of the State's proportion of the 'literary fund' of Virginia and other sources, for the support of free schools throughout the State and for no other purpose whatever.' The Legislature is directed to 'provide as soon as practicable for the establishment of a thorough and efficient system of free schools,' for the election of a State Superintendent, for township taxation for free schools, for the proper care of the blind, deaf mutes, and insane, and the organization of such institutions of learning as the best interests of general education in the State may demand.

The system of free schools established in 1865, provide for: (1,) A general superintendent of free schools; (2,) county superintendents, elected by the people, for two years; (3,) township commissioners, three for each township, one elected each year for a term of three years; (4,) district trustees, appointed by the township board, from the residents of the district for which the school is provided; (5,) State Board of the School Fund, for the management of any fund set apart for the support of free schools.

In 1871, there were 2,357 public schools, with 87,330 pupils enrolled under 2,303 teachers in 2,113 school-houses, estimated to have cost $2,257,744. The total expenditure for the year, for all objects, exceeded $565,000.

Dr. Sears applied $18,000 in aid of normal instruction in the State University, State Normal School at Fairmount, and the teachers' department in Marshall College, as well as to the establishment of the graded schools, and to the Teachers' Institutes.

Institutes were held at twenty different points with manifest advantage to teachers, and to the school interest, of the localities where held.

The support of schools falls mainly on a capitation tax of one dollar on each male inhabitant, over twenty-one years, and a tax of ten cents on every one hundred dollars of taxable property.

### WISCONSIN.

Wisconsin was detached from the Territory of Michigan and organized an independent Territory in 1836, and admitted a State in 1848, with a population in 1850, on an area of 53,954 square miles, of 305,391, which had increased in 1870 to 1,054,670, with $333,447,568 taxable property.

By the constitution of 1848, the supervision of public instruction is invested in a State Superintendent, to be chosen by the qualified electors of the State; the proceeds of all lands donated by the United States to the State for educational purposes are secured inviolably (1,) for the maintenance of common schools in each school district, and the purchase of suitable libraries and apparatus; (2,) for the maintenance of academies and normal schools, and (3,) for a state university; each town and city is required to raise by a tax, annually, for the support of free common schools therein, a sum not less than one-half the amount received by each town or city for school purposes, from the income of the school fund.

The first school law dates from 1849, by which all the territory in the organized towns is divided into school districts, the affairs of which are managed by three district officers, subject to the general supervision of the town school superintendent.

In 1857, twenty-five per cent. of the income of all swamp and overflowed lands granted to the State were constituted a normal school fund, the avails of which was first applied to colleges and academies which supported normal classes, but in 1865, the entire sales constitute a special fund for the support of State Normal Schools, of which five are now located. The capital of the Normal Fund is now about $1,000,000; and the Common School Fund, $2,500,000.

According to the last official report (of Samuel Fallowes) for 1872, there were 5,103 districts (excluding cities), with 423,717 persons of the school age (4 to 20), and the whole number of all ages attending public schools, 270,292; private schools, 18,020; academies and colleges, 2,831; benevolent institutions, 1,200; or an aggregate attendance for 1872, of 292,343.

The number of school-houses returned was 4,920, with accommodations for 312,-612, valued at $3,295,268. The productive capital of the school fund is $2,482,771, and the aggregate expenditure for schools, $2,174,154.

From this brief but comprehensive survey of the historical development of public instruction, and especially of common schools in the different States, it appears that:

1. The universal education of the people is now regarded among the primary objects of legislation, and a system of common or public schools is now ordained in the constitution or fundamental law, and organized and administered by legally constituted authorities in every State and Territory.

2. In every State there is a department of public instruction, under either a board or a single officer, charged with the supervision of this great interest, and in communication with the subordinate officers in the remotest and smallest corporation into which the territory may be divided.

3. For the accommodation and support of public schools, permanent funds, amounting in the aggregate to over $100,000,000 are set apart; and all property, real and personal, is subject to state and local taxation, and was assessed in 1871 to the amount of over $75,000,000 for public school purposes.

4. To provide local accommodations and material facilities for public schools, within the last twenty-five years, upwards of $100,-000,000 have been invested in school-houses and their equipment.

5. To realize an adequate return from this immense expenditure, more than 100 state and city normal and training schools have been established, and a system of examination and instruction instituted, more or less efficient, to exclude incompetent teachers; and to improve the qualifications of persons actually engaged in the work of instruction, more than 500 institutes are now held annually, in which over 50,000 teachers spend from three to five days in professional studies and exercises.

6. Notwithstanding this legislation and these expenditures, the non-school attendance and the adult illiteracy of the country is alarming, the national census of 1870 returning 4,528,084 persons, ten years of age and over, who can not read, and 5,658,144 who can not write; and of the last number 4,880,371 are native born.

7. The national census of 1870 returns 125,056 public schools of different grades, with 183,198 (109,024 females) teachers; 6,228,060 pupils (about equally divided as to sex); and a total expenditure of $64,-030,673, of which sum $58,855,507 came from taxation.

TABLE.—*Population, Taxable Property, Schools, Illiteracy, &c.*

| States. | NATIONAL CENSUS OF 1870. Area in Square Miles. | Population in 1870. | Taxable Property in 1870. | Schools of all kinds. Number. | Teachers. | Pupils. | Cost. | Number of Persons over 10 years of age, who Can not read. | Can not write. | Persons between 5 and 18. | STATE STATISTICS OF 1872. No. of Public Schools. | Permanent School Fund. | School-houses, ground, and equipments. | Cost of Public Schools in 1872. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama........ | 50,722 | 996,992 | $156,770,387 | 2,969 | 3,364 | 75,866 | $976,351 | 349,771 | 383,012 | 342,976 | 2,500 | $2,000,000 | $500,000 | $700,000 |
| Arkansas........ | 52,198 | 484,471 | 94,168,847 | 1,978 | 2,297 | 81,526 | 681,962 | 111,799 | 133,339 | 165,492 | 1,900 | 500,000 | 400,000 | 600,000 |
| California........ | 188,981 | 560,247 | 269,644,068 | 1,548 | 2,444 | 85,507 | 2,946,308 | 24,877 | 31,716 | 137,129 | 1,400 | 3,000,000 | 2,000,000 | 2,000,000 |
| Connecticut...... | 4,750 | 537,454 | 322,553,488 | 1,917 | 2,926 | 98,621 | 1,856,279 | 19,680 | 29,616 | 138,962 | 1,600 | 2,800,000 | 3,000,000 | 1,503,617 |
| Delaware........ | 2,120 | 125,015 | 64,787,223 | 375 | 510 | 19,577 | 212,712 | 19,350 | 23,100 | 39,807 | 330 | 300,000 | 200,000 | 200,000 |
| Florida.......... | 59,268 | 187,748 | 32,480,843 | 377 | 482 | 14,670 | 154,569 | 66,238 | 71,803 | 63,897 | 400 | 300,000 | 200,000 | 80,000 |
| Georgia.......... | 58,000 | 1,184,109 | 227,219,519 | 1,880 | 2,432 | 66,150 | 1,253,299 | 418,553 | 468,593 | 407,516 | 300 | 300,000 | 200,000 | 700,000 |
| Illinois.......... | 55,410 | 2,539,891 | 482,899,575 | 11,835 | 24,056 | 767,775 | 9,970,009 | 86,368 | 133,584 | 818,766 | 11,156 | 6,382,248 | 18,373,880 | 7,000,000 |
| Indiana.......... | 33,809 | 1,680,637 | 663,455,044 | 9,073 | 11,652 | 464,477 | 2,499,511 | 86,634 | 127,124 | 567,175 | 8,759 | 7,282,639 | 8,000,000 | 4,000,000 |
| Iowa............ | 55,045 | 1,194,792 | 302,515,418 | 7,496 | 9,319 | 217,654 | 3,570,093 | 24,115 | 45,671 | 394,696 | 7,716 | 3,174,578 | 6,764,551 | 3,265,000 |
| Kansas.......... | 81,318 | 364,399 | 92,125,861 | 1,689 | 1,955 | 59,882 | 787,226 | 16,369 | 24,550 | 108,710 | 3,400 | 1,000,000 | 2,845,226 | 1,700,950 |
| Kentucky........ | 37,680 | 1,321,011 | 407,544,294 | 5,149 | 6,346 | 245,139 | 2,538,429 | 249,567 | 332,176 | 454,539 | 5,068 | 2,500,000 | 500,000 | 1,000,000 |
| Louisiana ....... | 41,346 | 726,915 | 254,371,830 | 592 | 1,902 | 60,171 | 1,199,684 | 257,184 | 276,158 | 226,114 | 600 | 1,340,000 | 500,000 | 800,000 |
| Maine.......... | 35,000 | 626,915 | 204,253,780 | 4,723 | 6,986 | 162,636 | 1,106,203 | 13,486 | 19,052 | 175,588 | 4,000 | 317,902 | 2,644,264 | 1,112,373 |
| Maryland........ | 11,124 | 780,894 | 423,834,918 | 1,779 | 3,287 | 107,384 | 1,998,215 | 114,100 | 135,499 | 244,454 | 1,500 | 1,000,000 | 2,000,000 | 1,200,000 |
| Massachusetts.... | 7,800 | 1,457,351 | 1,417,127,376 | 5,726 | 7,561 | 269,337 | 4,817,939 | 74,935 | 97,742 | 371,820 | 5,076 | 2,182,419 | 17,559,718 | 3,594,686 |
| Michigan........ | 56,451 | 1,184,059 | 272,242,917 | 5,595 | 9,559 | 266,627 | 2,550,018 | 34,613 | 53,127 | 358,530 | 5,500 | 2,700,000 | 6,234,797 | 4,000,000 |
| Minnesota........ | 83,531 | 439,706 | 84,135,332 | 2,479 | 2,886 | 107,266 | 1,011,769 | 12,747 | 24,413 | 142,665 | 2,700 | 2,831,000 | 1,700,000 | 4,000,000 |
| Mississippi....... | 47,156 | 827,922 | 177,288,892 | 1,561 | 1,728 | 43,451 | 780,339 | 291,718 | 313,310 | 278,999 | 3,450 | 1,000,000 | 200,000 | 500,000 |
| Missouri......... | 65,350 | 1,721,295 | 566,129,969 | 6,750 | 9,028 | 370,337 | 4,340,805 | 146,771 | 222,411 | 577,801 | 7,547 | 3,271,581 | 4,000,000 | 2,000,000 |
| Nebraska........ | 75,995 | 122,993 | 56,584,656 | 796 | 840 | 17,614 | 270,560 | 2,365 | 4,861 | 34,523 | 1,050 | 1,000,000 | 560,000 | 363,000 |
| Nevada.......... | 104,125 | 42,491 | 25,740,973 | 53 | 84 | 2,373 | 110,493 | 727 | 872 | 5,337 | 53 | 500,000 | 200,000 | 100,000 |
| New Hampshire.. | 9,280 | 318,300 | 149,065,290 | 2,512 | 3,355 | 64,677 | 574,898 | 7,618 | 9,926 | 78,766 | 2,452 | 300,000 | 1,870,000 | 468,000 |
| New Jersey...... | 8,320 | 906,096 | 624,868,971 | 1,893 | 3,889 | 129,800 | 2,982,250 | 37,057 | 54,687 | 262,862 | 2,597 | 1,556,860 | 500,000 | 2,003,000 |
| New York....... | 47,000 | 4,382,759 | 1,964,001,185 | 13,020 | 28,918 | 862,022 | 15,936,783 | 163,501 | 239,271 | 1,230,988 | 12,500 | 7,000,000 | 23,468,266 | 9,000,000 |
| North Carolina... | 50,704 | 1,071,361 | 130,378,622 | 2,161 | 2,692 | 64,958 | 635,892 | 339,789 | 397,690 | 359,910 | 1,398 | 1,632,000 | 200,000 | 800,000 |
| Ohio............ | 39,964 | 2,665,260 | 1,167,731,097 | 11,952 | 23,589 | 790,795 | 10,244,648 | 92,720 | 173,172 | 845,971 | 14,201 | 4,000,000 | 17,168,196 | 5,293,221 |
| Oregon.......... | 95,274 | 90,923 | 31,798,510 | 637 | 826 | 32,593 | 248,022 | 2,609 | 4,427 | 29,400 | 600 | 1,000,000 | 100,000 | 150,000 |
| Pennsylvania..... | 46,000 | 3,521,951 | 1,243,367,852 | 14,872 | 19,522 | 811,863 | 9,628,119 | 131,728 | 222,356 | 1,076,040 | 16,000 | ........ | 18,689,624 | 8,345,072 |
| Rhode Island..... | 1,306 | 217,353 | 213,570,353 | 561 | 951 | 32,596 | 565,012 | 15,416 | 21,921 | 55,775 | 720 | 250,000 | 1,000,000 | 465,263 |
| South Carolina... | 34,000 | 705,606 | 183,913,337 | 750 | 1,103 | 38,249 | 577,953 | 265,892 | 290,379 | 233,915 | 700 | ........ | 200,000 | 500,000 |
| Tennessee........ | 45,600 | 1,258,520 | 257,673,792 | 2,794 | 3,587 | 125,831 | 1,650,692 | 290,549 | 364,697 | 429,592 | 2,000 | 2,400,000 | 500,000 | 800,000 |
| Texas........... | 274,356 | 818,579 | 149,734,792 | 548 | 706 | 23,076 | 414,880 | 189,423 | 221,703 | 284,851 | 500 | 2,267,971 | 100,000 | 300,000 |
| Vermont......... | 10,212 | 330,551 | 102,548,528 | 3,084 | 5,160 | 32,913 | 707,292 | 15,185 | 17,706 | 89,831 | 3,000 | ........ | 1,265,387 | 526,000 |
| Virginia......... | 38,348 | 1,225,163 | 365,439,917 | 2,021 | 2,697 | 60,019 | 1,155,585 | 390,913 | 445,893 | 396,812 | 3,695 | 1,595,069 | 387,672 | 993,318 |
| West Virginia.... | 23,000 | 442,014 | 140,538,273 | 2,445 | 2,838 | 104,949 | 698,061 | 48,802 | 81,490 | 150,844 | 2,303 | 250,000 | 2,527,744 | 600,000 |
| Wisconsin........ | 53,924 | 1,054,670 | 333,447,568 | 4,943 | 7,955 | 344,014 | 2,600,310 | 35,031 | 55,441 | 354,016 | 5,300 | 2,482,771 | 3,295,268 | 2,174,771 |
| Total........ | 1,984,467 | 38,115,332 | 13,646,948,450 | 141,629 | 220,022 | 7,178,737 | 95,153,370 | 4,438,206 | 5,552,488 | 12,045,443 | 144,971 | 70,417,038 | 150,194,573 | 72,938,271 |

## II. SECONDARY INSTRUCTION.

The first public schools of the American colonies were the free endowed grammar schools and subscription grammar schools; schools for secondary education. Public primary or elementary common schools were of later date, both in chronological order, and as being a logical result of their predecessors of higher grade.

The first school laws, those of Connecticut and Massachusetts, which were subsequent to the establishment by individuals or towns of the classes of schools they referred to, recognized all three grades of educational institutions, both what are at present termed common or elementary, and also secondary or superior; that is to say, common or neighborhood schools, grammar schools, and colleges.

The class of secondary schools, since the very earliest period of their establishment, has been far less cherished and supported, either by public opinion or by legal provisions, than either of the other two classes. Almost universally, the academy, the endowed school, the grammar school, has been wholly left to the support of those wealthier or more learned classes who have been tacitly assumed to have the only use for them; and where any state assistance has been extended to them, it has usually been in the exceptional form of individual acts of incorporation or individual grants of money or land.

It may be observed that such a co-equal public recognition, if extended to the class of secondary schools, would at once produce a definite and important result, in throwing probably half of what may be termed the present secondary course of study back within the course of the elementary grade of schools, and also in bringing back a large number of what are termed colleges into their appropriate grade of secondary institutions.

The noticeable and important fact is moreover thus brought out, that public opinion in the United States has never, up to the present time, demanded or recognized any universal privilege of education beyond that in the merest rudiments of it.

This neglect has of course caused the existing almost entire deficiency of recorded statistics of schools of this class. Such statistics are not accessible at all, except in the single state of New York, and even there, only from such secondary institutions as are obliged to furnish them as a condition of their receipt of a portion of the literature fund. This remark is not applicable to the grade of schools known as public high schools, for boys or girls, or both, in several of our larger cities; but these schools, few in number and of modern origin, are not so much the outgrowth of popular feelling, as the creations of a few intelligent friends of public education, in advance of any general demand for this class of institutions. Although not recognized generally as part of our systems of public instruction, schools of the former class have increased rapidly, and now exist in almost every village in the land, and their aggregate number in 1850, according to the census of that year, will be seen in the table on page 451.

The progress of this class of schools, in respect to studies, books, and equipment generally, and methods of instruction and discipline, can be readily measured by any one who will look into the best academy or public high school in his neighborhood, and then read the following communications—the first by the Hon. Josiah Quincy, respecting one of the earliest institutions of the class known as academies; and the other two by eminent public men, respecting the public schools, and particularly the Latin school of Boston, as it was prior to or about the beginning of the present century, and at that time pronounced "the best on the American continent."

"Mr. Barnard: *Dear Sir*—You ask briefly the position of Phillips Academy as to studies, text-books, methods, and discipline. That academy was founded in the year 1778, in the midst of the war of the Revolution, by the united contributions of three brothers—Samuel, John, and William Phillips—all of them men of property according to the scale of that day, and all of a liberal spirit toward every object, religious, moral, or educational. But the real author and instigator of that foundation was the only son of the first of the above-named, who was known during the early period of his life by the name of *Samuel Phillips, Junior.* He was, during his whole life, one of the most distinguished, exemplary, and popular men in Massachusetts: active, spirited, influential, and ready, and a leader in every good work;

and he had the control of the hearts of his father and two uncles, and was undoubtedly the influential spirit giving vitality to the plan of that institution. There was only one academy in the state at that time—Dummer Academy at Newbury—which, although it had sent forth many good scholars, was then going to decay; and the beautiful and commanding site in the south parish of Andover which that institution now occupies, was unquestionably one of the causes of the idea of the institution as well as of its locality. Eliphalet Pearson had been educated at Dummer Academy, was distinguished for his scholarship and zeal in the cause of classical learning; Samuel Phillips, jr., had formed an intimacy with him at college, though in different classes, and entertained a high opinion both of his literary attainments and spirit of discipline. Phillips Academy was projected with reference to his becoming its first master; and his aid was joined with that of his friend Phillips in forming the constitution of the academy.

"The time of its foundation was unquestionably most inauspicious to its success, but young Phillips was of a spirit that quailed before no obstacles. It was designed to be a model institution of the kind, and no pains were omitted to secure its success; and notwithstanding the uncertainties of the political aspect of the time and the perpetually increasing depreciation of paper money, it was sustained in great usefulness and prosperity. I was sent to that academy within a month after its opening, in May, 1778, being the seventh admission on its catalogue. I had just then entered upon my seventh year, and was thrust at once into my Latin at a period of life when noun, pronoun, and participle were terms of mysterious meaning which all the explanations of my grammars and my masters for a long time vainly attempted to make me comprehend. But the laws of the school were imperious. They had no regard for my age, and I was for years submitted to the studies and discipline of the seminary, which, though I could repeat the former, through want of comprehension of their meaning, I could not possibly understand. I was sent to the academy two years at least before I ought to have been. But William Phillips was my grandfather; it was deemed desirable that the founders of the academy should show confidence in its advantages; I was, therefore, sent at once, upon its first opening, and I have always regarded the severe discipline to which I was subjected, in consequence of the inadequacy of my years to my studies, as a humble contribution toward the success of the academy.

"The course of studies and text-books I do not believe I can from memory exactly recapitulate; I cannot, however, be far out of the way in stating that 'Cheever's Accidence' was our first book; the second, 'Corderius;' the third, 'Nepos;' then, if I mistake not, came 'Virgil.' There may have been some intermediate author which has escaped my memory, but besides Virgil I have no recollection of any higher author.

"Our grammar was 'Ward's,' in which all the rules and explanations are in Latin, and we were drilled sedulously in writing this language far enough to get into the university. Our studies in Greek were very slight and superficial. Gloucester's Greek Grammar was our guide in that language, and a thorough ability to construe the four Gospels was all required of us to enter the college.

"These are the best answers I can give to your inquiries on the subject of 'studies and text-books,' but I am not confident that my memory serves me with exactness. Our preparation was limited enough, but sufficient for the poverty and distracted state of the period.

"Of 'methods and discipline,' for which you inquire, I can only say that the former was strict and exact, and the latter severe. Pearson was a convert to thorough discipline; monitors kept an account of all of a student's failures, idleness, inattention, whispering, and like deviations from order, and at the end of the week were bestowed substantial rewards for such self-indulgences, distributed upon the head and hand with no lack of strength or fidelity.

"In that day arithmetic was begun at the university. The degree of preparation for college and the amount of the studies within it are not worthy of remembrance when compared with the means of acquirement now presented to the aspiring student.

"Your other inquiries I should be happy to make the subject of reply, but long cessation of familiarity with the objects to which they relate makes me dubious of my power to add any thing important to their history. My knowledge of the common schools of Boston was obtained only during the vacations of the academy, and had chief reference to improvement in my writing. Their advantages were few enough and humble enough; the education of females very slight, and limited to reading, writing, and the earlier branches of arithmetic.

"The interests of schools and of education were, thirty years ago, subjects of my thought and writing; but the lapse of time and the interposition of other objects and new duties deprive me of the power of aiding your researches on these subjects, which are, however, easily and far better satisfied by the active men of the day. Wishing you all success in these wise and noble pursuits,

"I am, very truly,

"Your friend and servant,

"JOSIAH QUINCY."

"BOSTON, Dec. 1st, 1860."

The following "Memorandum of an eminent clergyman, who was educated in the best schools of Boston just before the Revolution," we copy from a volume of the "Massachusetts Common School Journal," vol. xii., pp. 311, 312. The notes are by the editor of the Journal, Wm. B. Fowle:

"At the age of six and a half years, I was sent to Master John Lovell's Latin school. The only requirement was reading well; but, though fully qualified, I was sent away to Master Griffith, a private teacher, to learn to read, write and spell. I learned the English Grammar in Dilworth's Spelling Book by heart. Griffith traced letters with a pencil, and the pupils inked them.

"Entered Lovell's school at seven years. Lovell was a tyrant, and his system one of terror. Trouncing* was common in the school. Dr. Cooper was one of his early scholars, and he told Dr. Jackson, the minister of Brookline, that he had dreams of school till he died. The boys were so afraid they could not study. Sam. Bradford, afterward sheriff, pronounced the *P* in *Ptolemy*, and the younger Lovell rapped him over the head with a heavy ferule.*

"We studied Latin from 8 o'clock till 11, and from 1 till dark. After one or two years, I went to the town school, to Master Holbrook, at the corner of West street, to learn to write; and to Master Proctor, on Pemberton's Hill, in the south-east part of Scollay's Building. My second, third, and fourth year, I wrote there, and did nothing else. The English boys alone were taught to make pens. Griffith was gentle, but his being a private teacher accounts for it.

"The course of study was, grammar; Esop, with a translation; Clarke's Introduction to writing Latin; Eutropius, with a translation; Corderius; Ovid's Metamorphoses; Virgil's Georgics; Æneid; Cæsar; Cicero. In the sixth year I began Greek, and for the first time attempted English composition, by translating Cæsar's Commentaries. The master allowed us to read poetical translations, such as Trappe's and Dryden's Virgil. I was half way through Virgil when I began Greek with Ward's Greek Grammar.

"After Cheever's Latin Accidence, we took Ward's Lily's Latin Grammer. After the Greek Grammar, we read the Greek Testament, and were allowed to use Beza's Latin translation. Then came Homer's Iliad, five or six books, using Clarke's translation with notes, and this was all my Greek education at school. Then we took Horace, and composed Latin verses, using the Gradus ad Parnassum. Daniel Jones was the first Latin scholar in 1771 or 1772,

* "Trouncing was performed by stripping the boy, mounting him on another's back, and whipping him with birch rods, before the whole school. James Lovell, the grandson of John, once related to us the following anecdote, which shows the *utility* of corporal punishment! It seems that a boy had played truant, and Master John had publicly declared that the offender should be trounced. When such a sentence was pronounced, it was understood that the other boys might seize the criminal, and take him to school by force. The culprit was soon seized by one party, and hurried to the master, who inflicted the punishment without delay. On his way home, the culprit met another party, who cried out, 'Ah, John Brown,' or whatever his name was, 'you'll get it when you go to school!' 'No, I shan't,' said the victorious boy, who felt that he had got the start of them, 'No, I shan't, for *I've got it*,' and, as he said this, he slapped his hand upon the part that had paid the penalty, thus, as the poet says, 'suiting the action to the word.'"

* "We saw this done by another Boston teacher, about thirty years ago, and when we remonstrated with him upon the danger of inflicting such a blow, upon such a spot, 'O, the caitiffs,' said he, 'it is good for them!' About the same time, another teacher, who used to strike his pupils upon the hand so that the marks and bruises were visible, was waited upon by a committee of mothers, who lived near the school, and had been annoyed by the outcries of the sufferers. The teacher promised not to strike the boys any more on the *hand*, and the women went away satisfied. But, instead of inflicting blows upon the hand, he inflicted them upon the soles of the feet, and made the punishment more severe."

and he was brother to Thomas Kilby Jones, who was no scholar, though a distinguished merchant afterward.

"I entered college at the age of fourteen years and three months, and was equal in Latin and Greek to the best in the senior class. Xenophon and Sallust were the only books used in college that I had not studied. I went to the private school from 11 to 12 A. M., and to the public from 3 to 5 P. M.

"The last two years of my school life, nobody taught English Grammar or Geography, but Col. Joseph Ward (son of Deacon Joseph Ward, of Newton, West Parish, blacksmith,) who was self-taught, and set up a school in Boston. He became aid to General Ward when the war commenced, and did not teach after the war.

"I never saw a map, except in Cæsar's Commentaries, and did not know what that meant. Our class studied Lowth's English Grammar at college. At Master Proctor's school, reading and writing were taught in the same room, to girls and boys, from 7 to 14 years of age, and the Bible was the only reading book. Dilworth's Spelling Book was used, and the New England Primer. The master set sums in our MSS. but did not go farther than the Rule of Three.

"Master Griffith was a thin man, and wore a wig, as did Masters Lovell and Proctor, but they wore a cap when not in full dress. James Lovell was so beaten by his grandfather John, that James the father rose and said, 'Sir, you have flogged that boy enough.' The boy went off determined to leave school, and go to Master Proctor's; but he met one of Master Proctor's boys, who asked whither he was going, and when informed, warned him not to go, for he would fare worse."

Hon. Edward Everett, in an address at the Annual School Festival in Faneuil Hall in 1852, gives the following account of the educational advantages he enjoyed in early life:—

"It was fifty-two years last April since I began, at the age of nine years, to attend the reading and writing schools in North Bennett street. The reading school was under Master Little, (for 'Young America' had not yet repudiated that title,) and the writing school was kept by Master Tileston. Master Little, in spite of his name, was a giant in stature—six feet four, at least—and somewhat wedded to the past. He struggled earnestly against the change then taking place in the pronunciation of *u*, and insisted on saying *monooment* and *natur*. But I acquired, under his tuition, what was thought in those days a very tolerable knowledge of Lindley Murray's abridgment of English grammar, and at the end of the year could parse almost any sentence in the 'American Preceptor.' Master Tileston was a writing master of the old school. He set the copies himself, and taught that beautiful old Boston handwriting, which, if I do not mistake, has, in the march of innovation, (which is not always the same thing as improvement,) been changed very little for the better. Master Tileston was advanced in years, and had found a qualification for his calling as a writing master, in what might have seemed at first to threaten to be an obstruction. The fingers of his right hand had been contracted and stiffened in early life, by a burn, but were fixed in just the position to hold a pen and a penknife—and nothing else. As they were also considerably indurated, they served as a convenient instrument of discipline. A copy badly written, or a blotted page, was sometimes visited with an infliction which would have done no discredit to the beak of a bald eagle. His long, deep desk was a perfect curiosity-shop of confiscated balls, tops, penknives, marbles and Jews-harps—the accumulation of forty years. I desire, however, to speak of him with gratitude, for he put me on the track of an acquisition which has been extremely useful to me in after life—that of a plain, legible hand. I remained at these schools about sixteen months, and had the good fortune in 1804 to receive the Franklin medal in the English department. After an interval of about a year, during which I attended a private school kept by Mr. Ezekiel Webster, of New Hampshire, and on an occasion of his absence, by his ever memorable brother, Daniel Webster, at that time a student of law in Boston, I went to the Latin school, then slowly emerging from a state of extreme depression. It was kept in School street, where the Horticultural Hall now stands. The standard of scholastic attainment was certainly not higher than that of material comfort in those days. We read pretty much the same books—or of the same class—in Latin and Greek, as are read now, but in a very cursory and superficial manner. There was no attention paid to the philosophy of the languages—to the deduction of words from their radical elements—to the niceties of construction—still less to prosody. I never made a hexameter or pentameter verse till, years afterward, I had a son at school in London, who occasionally required a little aid in that way. The subsidiary and illustrative branches were wholly unknown in the Latin school in 1805. Such a thing as a school library, a book of reference, a critical edition of a classic, a map, a blackboard, an engraving of an ancient building, or a copy of a work of ancient art, such as now adorn the walls of our schools, was as little known as the electric telegraph. If our children, who possess all these appliances and aids to learning, do not greatly excel their parents, they will be much to blame."

*Academy Life in Philadelphia about* 1760.

Graydon, in "*Memoirs of a Life chiefly passed in Philadelphia, within the last sixty* [1752–1811] *years*," printed in Harrisburgh by John Wyeth, 1811, after noting his first teacher in Bristol, where he was born, as a kind, good-humored Irishman, by the name of Pinkerton, and his first teacher in Philadelphia, an Englishman (David James Dove), much celebrated in his day both as teacher and maker of a minor kind of satirical poetry, chronicles his admission into the principal seminary in Pennsylvania, then as now bearing the name of a university.

"I was now about eight years of age, and my first introduction was to Mr. Kinnersley, the teacher of English and Professor of Oratory. He was an Anabaptist clergyman, a large, venerable looking man, of no great general erudition, though a considerable proficient in electricity; and who, whether truly or not, has been said to have had a share in certain discoveries in that science, of which Doctor Franklin received the whole credit. The task of the younger boys, at least, consisted in learning to read and to write their mother tongue grammatically; and one day in the week (I think Friday) was set apart for the recitation of select passages in poetry and prose. For this purpose, each scholar, in his turn, ascended the stage, and said his speech, as the phrase was. This speech was carefully taught him by his master, both with respect to its pronunciation, and the action deemed suitable to its several parts. Two of these specimens of infantile oratory, to the disturbance of my repose, I had been qualified to exhibit: family partiality, no doubt, overrated their merit: and hence, my declaiming powers were in a state of such constant requisition, that my orations, like worn out ditties, became vapid and fatiguing to me; and consequently impaired my relish for that kind of acquirement. More profit attended my reading. After Æsop's fables, and an abridgment of the Roman history, Telemachus was put into our hands; and if it be admitted that the human heart may be bettered by instruction,' mine, I may aver, was benefited by this work of the virtuous Fenelon. While the mild wisdom of Mentor called forth my veneration, the noble ardor of the youthful hero excited my sympathy and emulation. I took part, like a second friend, in the vicissitudes of his fortune, I participated in his toils, I warmed with his exploits, I wept where he wept, and exulted where he triumphed.

"A few days after I had been put under the care of Mr. Kinnersley, I was told by my classmates that it was necessary for me to fight a battle with some one in order to establish my claim to the honor of being an academy boy; that this could not be dispensed with, and that they would select for me a suitable antagonist, *one of my match*, whom after school I must fight, or be looked upon as a coward. I must confess that I did not at all relish the proposal. Though possessing a sufficient degree of spirit, or at least irascibility, to defend myself when assaulted, I had never been a boxer. Being of a light and slender make, I was not calculated for the business, nor had I ever been ambitious of being the cock of a school. Besides, by the laws of the institution I was now a subject of, fighting was a capital crime; a sort of felony deprived of clergy, whose punishment was not to be averted by the most scholar-like reading. For these reasons, both of which had sufficient weight with me, and the last, not the least, as I had never been a willful transgressor of rules, or callous to the consequences of an infraction of them, I absolutely declined the proposal; although I had too much of that feeling about me, which some might call false honor, to represent the case to the master, which would at once have extricated me from my difficulty, and brought down condign punishment on its imposers. Matters thus went on until school was out, when I found that the lists were appointed, and that a certain John Appowen, a lad who, though not quite so tall, yet better set and older than myself, was pitted against me. With increased pertinacity I again refused the combat, and insisted on being permitted to go home unmolested. On quickening my pace for this purpose, my persecutors, with Appowen at their head, followed close at my heels. Upon this I moved faster and faster, until my retreat became a flight too unequivocal and inglorious for a man to relate of himself, had not Homer furnished some apology for the procedure, in making the heroic Hector thrice encircle the walls of Troy, before he could find courage to encounter the implacable Achilles. To cut the story short, my spirit could no longer brook an oppression so intolerable, and stung to the quick at the term coward which was lavished upon me, I made a halt and faced my pursuers. A combat immediately ensued between Appowen and myself, which for some time was maintained on each side with equal vigor and determination, when, unluckily, I received his fist directly in my gullet. The blow for a time depriving me of breath and the power of resistance, victory declared for my adversary, though not without the acknowledgment of the party that I had at last behaved well, and shown myself not unworthy of the name of an academy boy. Being thus established, I had no more battles imposed upon me, and none that I can recollect, of my own provoking; for I have a right to declare that my general deportment was correct and unoffending, though extremely obstinate and unyielding under a sense of injustice.

"In March, 1761, I entered the Latin school, and became the pupil of Mr. John Beveridge, a native of Scotland, who retained the smack of his vernacular tongue in its primitive purity. His acquaintance with the language he taught, was I believe, justly deemed to be very accurate and profound. But as to his other acquirements, after excepting the game of backgammon, in which he was said to excel, truth will not warrant me in saying a great deal. He was, however, diligent and laborious in his attention to his school; and had he possessed the faculty of making himself beloved by the scholars, and of exciting their emulation and exertion, nothing would have been wanting in him to an entire qualification for his office. But unfortunately, he had no dignity of character, and was no less destitute of the art of making himself respected than beloved. Though not perhaps to be complained of as intolerably severe, he yet made a pretty free use of the ratan and the ferule, but to very little purpose. He was, in short, no disciplinarian, and consequently very unequal to the management of seventy or eighty boys, many of whom were superlatively pickle and unruly. He was assisted, indeed, by two ushers, who eased him in the burden of teaching, but who, in matters of discipline, seemed disinclined to interfere, and disposed to consider themselves rather as subjects than rulers. I have seen them slily slip out of the way when the principal was entering upon the job of capitally punishing a boy, who from his size would be likely to make resistance. For this had become nearly a matter of course; and poor Beveridge, who was diminutive in his stature and neither young nor vigorous, after exhausting himself in the vain attempt to denude the delinquent, was generally glad to compound for a few strokes over his clothes, on any part that was accessible. He had, indeed, so frequently been foiled, that his birch at length was rarely brought forth, and might truly be said to have lost its terrors—it was *tanquam gladium in vagina repositum.* He indemnified himself, however, by a redoubled use of his ratan.

"So entire was the want of respect towards him, and so liable was he to be imposed upon, that one of the larger boys, for a wager, once pulled off his wig, which he effected by suddenly twitching it from his head under pretense of brushing from it a spider; and the unequivocal insult was only resented by the peevish exclamation of *hoot mon!*

"Various were the rogueries that were played upon him; but the most audacious of all was the following. At the hour of convening in the afternoon, that being found the most convenient, from the circumstance of Mr. Beveridge being usually a little beyond the time; the bell having rung, the ushers being at their posts, and the scholars arranged in their classes, three or four of the conspirators conceal themselves without, for the purpose of observing the motions of their victim. He arrives, enters the school, and is permitted to proceed until he is supposed to have nearly reached his chair at the upper end of the room, when instantly the door and every window-shutter is closed. Now, shrouded in utter darkness, the most hideous yells that can be conceived are sent forth from at least three score of throats; and Ovids, and Virgils, and Horaces, together with the more heavy metal of dictionaries, whether of Cole, of Young, or of Ainsworth, are hurled without remorse at the head of the astonished preceptor, who, on his side, groping and crawling under cover of the forms, makes the best of his way to the door. When attained, and light restored, a death-like silence ensues. Every boy is at his lesson; no one has had a hand or a voice in the recent atrocity; what then is to be done, and who shall be chastised.

*Sævit atrox Volscens, nec teli conspicit usquam*
*Auctorem, nec quo se ardens immittere possit.*

Fierce Volscens foams with rage, and gazing round
Descries not him who aim'd the fatal wound;
Nor knows to fix revenge.

"This most intolerable outrage, from its succeeding beyond expectation, and being entirely to the taste of the school, had a run of several days; and was only then put a stop to by the interference of the *faculty*, who decreed the most exemplary punishment on those who should be found offending in the premises, and by taking measures to prevent a further repetition of the enormity.

"The ushers, during the term of my pupilage, a period of four years or more, were often changed; and some of them, it must be admitted, were insignificant enough; but others, were men of sense and respectability, to whom, on a comparison with the principal, the management of the school might have been committed with much advantage. Among these was Mr. Patrick Allison, afterwards officiating as a Presbyterian clergyman in Baltimore; Mr. James Wilson, late one of the associate justices of the Supreme Court of the United States; and Mr. John Andrews, now Doctor Andrews of the University of Pennsylvania. It is true they were much younger men than Mr. Beveridge, and probably unequal adepts in the language that was taught; but even on the supposition of this comparative deficiency on their part, it would have been amply compensated by their judicious discipline and instruction.

"With respect to my progress and that of the class to which I belonged, it was reputable and perhaps laudable for the first two years. From a pretty close application, we were well grounded in grammar, and had passed through the elementary books, much to the approbation of our teachers; but at length, with a single exception, we became possessed of the demons of liberty and idleness. We were, to a great degree, impatient of the restraints of a school; and if we yet retained any latent sparks of the emulation of improvement, we were unfortunately never favored with the collision that could draw them forth. We could feelingly have exclaimed with Louis the Fourteenth, *mais a quoi sert de lire!* but where's the use of all this pouring over books! One boy thought he had Latin enough, as he was not designed for a learned profession; his father thought so too, and was about taking him from school. Another was of opinion that he might be much better employed in a counting-house, and was also about ridding himself of his scholastic shackles. As this was a consummation devoutly wished by us all, we cheerfully renounced the learned professions for the sake of the supposed liberty that would be the consequence. We were all, therefore, to be merchants, as to be mechanics was too humiliating; and accordingly, when the question was proposed, which of us would enter upon the study of Greek, the grammar of which tongue was about to be put into our hands, there were but two or three who declared for it. As to myself, it was my mother's desire, from her knowing it to have been my father's intention to give me the best education the country afforded, that I should go on, and acquire every language and science that was taught in the institution; but as my evil star would have it, I was thoroughly tired of books and confinement, and her advice and even entreaties were overruled by my extreme repugnance to a longer continuance in the college, which, to my lasting regret, I bid adieu to when a little turned of fourteen, at the very season when the minds of the studious begin to profit by instruction. We were at this time reading Horace and Cicero, having passed through Ovid, Virgil, Cæsar and Sallust. From my own experience on this occasion, I am inclined to think it of much consequence, that a boy designed to complete his college studies, should be classed with those of a similar destination."

A picture of academy life prior to 1800—its material outfit of building and apparatus, its teachers, studies, and students, in Georgia and Virginia, has already been given, and does not differ essentially from "the beggarly elements" above described.

*Public High Schools—Endowed Academies.*

In the original organization of public instruction in New England, provision was made for a school of a higher order than the common district or neighborhood school, where the mother tongue, penmanship and arithmetic were taught to all, so that "so much barbarism as a single child unable to read the Holy Word of God, and the good laws of the colony could not exist." This school in Massachusetts and New Hampshire was a town grammar school for all towns of one hundred families. In Connecticut the same original requisition gave place in 1672 to a school of the same grade for the head town of each county, and to diminish the expense of tuition, and ultimately to make the instruction gratuitous, was aided by grants of public lands, and to some extent endowed by individuals. By degrees in all parts of New England, where there was a difficulty in establishing the local grammar school, either from paucity of inhabitants, or want of popular appreciation of the necessity or the advantages of instruction of this grade, either the clergyman in his own house fitted young men for college, or a college graduate at his own risk opened a temporary school for pupils, whose parents desired for them more of arithmetic and grammar than could be obtained in the district school. In such places, if there were few men, or even one man of public spirit and energy, sooner or later an academic institution would spring up, towards the support of which donations or bequests would be made, and for its better management, corporate powers and grants of public lands would be asked and obtained from the legislature. In Massachusetts alone these charters and land grants were made originally, as a settled policy—only for districts where the grammar schools could not supply the wants of a higher education, and for not more than one institution in a large extent of territory like that of a county. By degrees this policy was forgotten and disregarded, even in Massachusetts, and charters were freely granted, and the Academies came to rival and supersede even the Town Grammar schools—until public attention was arrested to the fact, first by James G. Carter in 1824. From that time strenuous efforts have been made by the friends of public schools to restore the earlier and better policy, of Public High Schools for boys and girls in every city and town where the population was sufficient to furnish a quota of scholars, who could at once reside with their parents and get the advantages of the higher education.* To provide for children and youth in smaller towns and in more sparsely populated counties, where they are obliged to go away from home for a higher education, Academies and Seminaries have been largely endowed, so as to reduce the cost of tuition and the expense of residence. These schools are becoming fewer in number, but the few are better endowed, and better equipped for the work of classical and scientific teaching.

*Academies out of New England.*

Out of New England generally, where the township plan of settlement did not prevail, and where even neighborhood schools were not provided for or made obligatory by law, the educational wants of the few families, who cared for higher, as well as elementary instruction for their older and younger children, could be most readily and economically obtained for them by associated efforts, which soon resulted in special charters for convenience of management; and hence all over the country the policy of Academies, not only for large districts, like one or more counties, but for all large towns and cities prevailed. In such States, the demand for educational facilities for the more wealthy and educated families being thus partially, and in some cases even liberally supplied, it has been difficult to overcome the force of habit, and inaugurate a school policy large and broad enough to provide at once for elementary and higher grades of schools at the public expense for the entire community. Without the higher element, the public school inevitably sinks down into a class institution—common, not only because it is rudimentary and cheap, but because it is poor and only for the poor.

By degrees the Graded System of Public Schools, presented by Mr. Mann and Mr. Barnard, and particularly by the latter in addresses delivered before the Legislatures and in the principal cities of seventeen States between the years 1842–1848, and in numerous publications on this subject, of which over 1,000,000 copies have been printed and distributed—was established in all the principal cities of the country, where are

* According to the Report of Massachusetts Board of Education for 1870, High Schools were maintained in 162 out of 335 towns in the State, embracing 82 per cent of the population, in nearly all the towns having over 2,000 inhabitants.

now found the best specimens of our American system of Public Instruction.

Outside of the Public High School, the incorporated and endowed Academies and Seminaries, until quite recently, were avowedly denominational in the religious profession of their teachers and the general influence of the institution. Recently, several schools of the secondary class have been established on the basis of corporate powers, but the instruction has been made free or cheap, and all sectarian preference and influence has been disavowed and guarded against. Of this class are the Putnam Free School at Newburyport, Mass., the Free Academy at Norwich, and the Morgan School at Clinton, in Connecticut.

*Female Seminaries and Colleges.*

Although variously designated, all the institutions for female education of the highest grade, yet established in this country, belong properly to the department of secondary instruction, these are nearly all the creation not only of the present century, but of the last twenty-five years. But before noticing a few of the more prominent institutions which are fast rising into grade of superior schools, we cite from a communication of Rev. William Woodbridge, an account of the education of girls as it was more than one hundred years ago.

Girls had no separate classes, though generally sitting on separate benches. A merchant from Boston, resident in my native town, who was desirous to give his eldest daughter the best education, sent her to that city, one quarter, to be taught needlework and dancing, and to improve her manners in good and genteel company. To *complete* this education, *another* quarter, the year following, was spent at Boston. A third quarter was then allowed her at the school of a lady in Hartford. Another female among my schoolmates was allowed to attend the same school for the period of three months, to attain the same accomplishments of needlework, good reading, marking, and polished manners. These are the only instances of female education, beyond that of the common schools before described, which I knew, in a town of considerable extent, on Connecticut river, until 1776.

You inquire how so many of the females of New England, during the latter part of the last century, acquired that firmness, and energy, and excellence of character for which they have been so justly distinguished, while their advantages of school education were so limited.

The only answer to this question must be founded on the fact, that it is not the amount of knowledge, but the nature of that knowledge, and still more, the manner in which it is used, and the surrounding influences and habits, which form the character. Natural logic—the self-taught art of thinking—was the guard and guide of the female mind. The first of Watt's five methods of mental improvement, "The attentive notice of every instructive object and occurrence," was not then in circulation, but was exemplified in practice. Newspapers were taken and read in perhaps half a dozen families, in the most populous villages and towns. Books, though scarce, were found in some families, and freely lent; and in place of a flood of books, many of which are trifling or pernicious, there were a few, of the best character. They were thoroughly read, and talked of, and digested. In town and village libraries, there were some useful histories, natural and political. Milton, Watts' Lyric Poems, Young's Night Thoughts, Hervey's Meditations, the Tattler, and Addison's Spectator, were not scarce, though not generally diffused. Pamela, Clarissa Harlow, and an abridgement of Grandison, were in a few hands, and eagerly read; and the Adventures of Robinson Crusoe, was the chief work of this kind for the young.

But the daily, attentive study of the Holy Scriptures, the great source of all wisdom and discretion, was deemed indispensable in those days, when every child had a Bible, and was accustomed to read a portion of the lesson at morning prayers. This study, with the use of Watts' Psalms (a book, which with all the defects it may have, contains a rich treasure of poetry and thought, as well as piety,) at home, at church, and in singing schools, I regard as having furnished, more than all other books and instructions, the means of mental improvement, for forty years of the last century.

When, at length, academies were opened for female improvement in the higher branches, a general excitement appeared in parents, and an emulation in daughters to attend them. Many attended such a school one or two quarters, others a year, some few longer. From these short periods of attendance for instruction in elementary branches, arose higher improvements. The love of reading and habits of application became fashionable; and fashion we know is the mistress of the world.

When the instruction of females in any of the departments of science was first proposed, it excited ridicule. The man who devoted his time and heart to the work was regarded as an enthusiast. The cry was—"What need is there of learning how far off the sun is, when it is near enough to warm us?" —"What, will the teacher learn his pupils to make Almanacs?"—"When girls become scholars, who is to make the puddings and the pies?" But these narrow prejudices have almost passed away. Many have since become equally enthusiasts on this subject, and the results of an improved system of female education have not disappointed their hopes or mine. By a true discipline of mind, and application to the solid branches of knowledge, our well educated females have become more agreeable companions, more useful members of society, and more skillful and faithful teachers, without disqualifying themselves for domestic avocations.

The first school of eminence exclusively for girls was the Moravian Seminary at Bethlehem, Pennsylvania. This was established as early as 1749, but was not opened as a boarding-school until 1785. It enjoyed about that date a national reputation. About the same period the Academy of the Visitation, at Georgetown, the first Catholic Seminary for girls in the United States, was established, and at this date there are upwards of fifty under the care of different religious orders in the different dioceses.

It has been claimed that President Dwight, in his school at Greenfield, opened in 1783, was the first in the country to admit pupils of both sexes to an entire equality of intellectual training of the highest order.

When that famous teacher, Caleb Bingham, removed to Boston, in 1784, he did so with the design of opening there a school for girls, who were, singularly enough, at that time excluded from the public schools. Mr. Bingham's enterprise was successful, and was also the means of revolutionizing the unfair school system of the city, and of introducing a plan which, though imperfect, provided some public instruction for girls. After many delays and defeats, the Girls' High School, in 1872, was left to occupy alone the largest, most costly, and best equipped school structure in the United States, under the direction of a principal (Samuel Eliot, LL. D.) who was recently a college president.

In 1792, Miss Pierce opened a school for girls at Litchfield, Connecticut, which continued in operation for forty years, and educated large numbers of young ladies from all parts of the country. In the same year, at Philadelphia, was incorporated the first Female Academy in this country.

From about 1797 to 1800, Rev. William Woodbridge, father of the well-known author and educator, W. C. Woodbridge, taught a young ladies' school, at first at Norwich, and afterward at Middletown, Ct. He had previously (in 1779) taught a class of young ladies in New Haven, Ct., and a Female Academy in 1789 at Medford, Mass.

In 1816, Mrs. Emma Willard commenced her endeavors to secure for women the opportunity of acquiring a grade of education corresponding to that which colleges furnish to the other sex. The eminent success and excellence of her celebrated school at Troy are well known; and an important consequence of her labors was, that female seminaries were admitted to receive aid from the literature fund of the State of New York, on the same terms with the male academies.

From 1818 to 1830, Rev. Joseph Emerson conducted a young ladies' school of high reputation and efficiency, successively at Byfield and Saugus, Mass., and Wethersfield, Conn. In 1823, George B. Emerson, LL. D., opened a young ladies' school at Boston, probably with a more complete outfit than any which had preceded it. Soon after, the well-known school of Mr. Kingsbury, an institution of similar grade and excellence, was opened at Providence. Miss Z. P. Grant and Miss Mary Lyon, both pupils of Rev. J. Emerson, were associated in the conduct of an excellent school for young ladies at Ipswich, Mass., in 1821. The energetic and persevering labors of Miss Lyon, with the purpose of establishing a permanent Protestant school of high grade for young ladies, resulted in the establishment of the celebrated seminary at South Hadley, which was opened in 1837. In 1839 the first Normal School for female teachers was opened at Framingham.

In 1822, Miss Catherine E. Beecher opened a school for young ladies at Hartford, Conn., which she conducted with eminent success for ten years. She afterward taught for a short period at Cincinnati, but her labors for female education have subsequently consisted in various publications, and in the management of an extended scheme for a system of Christian female education, including a national board, high schools, and normal schools; which has resulted in the establishment of several valuable institutions.

In 1825, at Wilbraham, Mass., was opened the first of the Methodist Conference seminaries—institutions whose plan has substantially followed that of the Wilbraham Seminary, which was drawn up by Rev. Wilbur Fiske, its first principal, and admitted young women as well as young men to their advantages. Ten years later, Oberlin College, at first with no higher range of studies, but since largely increased, extended all its courses to females as well as males, and fifty years later Cornell University, with public and private endowments out of which $2,000,000 will be realized, has opened all its optional classes and schools, and all its degrees to aspirants of both sexes on the same conditions. In the number of largely endowed female institutions is the Packer Collegiate Institute at Brooklyn, N. Y., which had previously existed as the Brooklyn Institute, and received its present name in consequence of the munificent gift of $85,000 by Mrs. Harriet L. Packer of that city; and Vassar Female College at Poughkeepsie, N. Y., for which the vast sum of $800,000 has been given by Matthew Vassar, of that city.

## III. COLLEGES, OR SUPERIOR INSTRUCTION.

### INTRODUCTION.

At the close of the Colonial period of our educational history, we have already noticed the fact of the existence of seven Colleges,—Harvard, William and Mary, Yale, Nassau Hall, Rutgers, Brown, and Kings—all of them founded on a common type, all of them including, as an essential part of their curriculum, the study of Latin and Greek, with special reference to the wants of the church, while they were all avowedly preparatory to the "learned professions of theology, law, and medicine" generally. By degrees the term University came to be applied to this class of institutions—which, without changing in any essential particular the aims or studies of the American College, has perverted and belittled one of the most significant and noblest terms in the annals of human culture. We have yet not a single institution which, by the independent test of its admission, and the optional range of its instruction, based on a preliminary institutional drill in the elementary principles of received science, is entitled to the designation of University in its best European sense. Our Universities, so called, with few honorable exceptions, can not, without great latitude of construction, be admitted into the classification of American Colleges; and great injury has been done to higher learning in this country by the indiscriminate incorporation of associations, all avowedly sectarian in their constitution and aims, with power to grant academic degrees, under the name of a college or university.

*Condition of American Colleges about* 1800.

The following account of all the Colleges in operation in 1796 is taken from Winterbotham's *Historical, Geographical, Commercial and Philosophical View of the United States*, published in four volumes in London in 1796. The information was obtained by personal inquiries, and from such sources as Morse, Webster, Wirtherspoon, &c. We have added a few paragraphs and notes respecting institutions omitted by the above author, to make the account complete to the beginning of this century.

Massachusetts.—Harvard University takes its date from the year 1638. Two years before, the General Court gave four hundred pounds for the support of a public school at Newtown, which has since been called Cambridge. This year (1638) the Rev. Mr. John Harvard, a worthy minister residing in Charlestown, died, and left a donation of seven hundred and seventy-nine pounds, for the use of the fore-mentioned public school. In honor to the memory of so liberal a benefactor, the General Court, the same year, ordered that the school should take the name of Harvard College.

In 1642, the college was put upon a more respectable footing, and the governor, deputy governor, and magistrates, and the ministers of the six next adjacent towns, with the president, were erected into a corporation for the ordering and managing its concerns. It received its first charter in 1650.

Cambridge, in which the university is situated, is a pleasant village, four miles westward from Boston, containing a number of elegant seats, which are neat and well-built. The university consists of four elegant brick edifices, handsomely inclosed. They stand on a beautiful green, which spreads to the north-west, and exhibit a pleasing view.

The names of the several buildings are, Harvard Hall, Massachusetts Hall, Hollis Hall, and Holden Chapel. Harvard Hall is divided into six apartments; one of which is appropriated for the library, one for the museum, two for the philosophical apparatus; one is used for a chapel, and the other for a dining hall. The library, in 1791, consisted of upwards of thirteen thousand volumes; and is continually increasing from the interest of permanent funds, as well as from casual benefactions. The philosophical apparatus belonging to this university, cost between one thousand four hundred, and one thousand five hundred pounds sterling, and is the most elegant and complete of any in America.

Agreeable to the present constitution of Massachusetts, his Excellency the Governor, Lieutenant-governor, the Council and Senate, the President of the University, and the ministers of the congregational churches in the towns of Boston, Charlestown, Cambridge, Watertown, Roxbury, and Dorchester, are, *ex officiis*, overseers of the university.

The corporation is a distinct body, consisting of seven members, in whom is vested the property of the university.

Harvard University has a President, Emeritus Professor of Divinity,—Hollisian Professor of Divinity,—Hancock Professor of Hebrew and other Oriental languages,—Hollis Professor of Mathematics and Natural Philosophy—Hersey Professor of Anatomy and Surgery,—Hersey Professor of the theory and practice of Physic,—Erving Professor of Chemistry and Materia Medica,—four tutors, who teach the Greek and Latin languages, logic, metaphysics, and ethics, geography, and the elements of geometry, natural philosophy, astronomy, and history; and a preceptor of the French language.

This university, as to its library, philosophical apparatus and professorships, is at present the first literary institution on the American continent. Since its first establishment, upwards of three thousand three hundred students have received honorary degrees from its successive officers; about one-third of whom have been ordained to the work of the gospel ministry. It has generally from one hundred and thirty to one hundred and sixty students.

This university is liberally endowed, and is frequently receiving donations for the establishment of new professorships. Formerly there was an annual grant made by the legislature to the president and professors, of from four to five hundred pounds, which for several years past has been discontinued.

[Williams College grew out of the avails of land and other property left by will of Col. Ephraim Williams, dated July 22, 1755, "for the support of a Free School in a township west of Fort Massachusetts." The land was in part a grant of 200 acres made to him by the General Court of Massachusetts for military service in the French war from 1740 to 1748. In 1785 a body of trustees to maintain a free school in Williamstown was incorporated by the legislature, a building erected, and a school opened in the same in 1791, with two departments—a grammar-school or academy, with a college course, and an English free school. In 1793 this school, by act of the legislature, became Williams College, with a grant of $4,000 from the State to purchase books and philosophical apparatus. The requirements for entering the college were, ability "to read, parse and construe, to the satisfaction of the president and tutor, Virgil's Æneid, Tully's Orations, and the Evangelists, in Greek; or if he prefers to become acquainted with French, he must be able to read, with a tolerable degree of accuracy and fluency, Hudson's French Scholars' Guide, Telemuchus, or some other approved French author.]

Virginia.*—The college of William and Mary was founded in the time of King William and Queen Mary [1692], who granted to it twenty thousand acres of land, and a penny a pound duty on certain tobaccos exported from Virginia and Maryland, which had been levied by the statute of 25 Car. II. The Assembly also gave it, by temporary laws, a duty on liquors imported, and skins and furs exported. From these resources it received upwards of three thousand pounds. The buildings are of brick, sufficient for an indifferent accommodation of perhaps one hundred students. By its charter it was to be under the government of twenty visitors, who were to be its legislators, and to have a president and six professors, who were incorporated: it was allowed a representative in the General Assembly. Under this charter, a professorship of the Greek and Latin languages, a professor of mathematics, one of moral philosophy, and two of divinity, were established. To these were annexed, for a sixth professorship, a considerable donation by a Mr. Boyle of England, for the instruction of the Indians, and their conversion to Christianity: this was called the professorship of Brasserton, from an estate of that name in England, purchased with the moneys given. The admission of the learners of Latin and Greek filled the college with children; this rendering it disagreeable to the young gentlemen already prepared for entering on the sciences, they desisted from resorting to it, and thus the schools for mathematics and moral philosophy, which might have been of some service, became of very little use. The revenues, too, were exhausted in accommodating those who came only to acquire the rudiments of science. After the present revolution, the visitors having no power to change those circumstances in the constitution of the college which were fixed by the charter, and being therefore confined in the number of professorships, undertook to change

* In 1619 a gift of 500*l.* was made to the Virginia Company to aid in the education of Indian youths. Collections were taken up in the Churches of England, by which 10,500*l.* were realized, and the company appropriated 10,000 acres of land at Henrico, a little below the present site of Richmond. Rev. Mr. Copelnad was made president, and George Thorpe, with 50 tenants, sent over in 1621 to improve the land. These were all slain by the Indians in the great massacre of 1622, and the project of the college was abandoned. In 1666 an attempt was made in the Assembly to establish a college "for the supp y of the ministry and the promotion of piety." In 1692 a charter was obtained from the government in England through the agency of Rev. James Blair, who became its president, and the assistance of Lieut. Governor Nicholson, and was called after its royal founders, William and Mary.

the objects of the professorships. They excluded the two schools for divinity, and that for the Greek and Latin languages, and substituted others; so that at present they stand thus—a professorship for law and police; anatomy and medicine; natural philosophy and mathematics; moral philosophy, the law of nature and nations, the fine arts; modern languages; for the Brasserton.

Measures have been taken to increase the number of professorships, as well for the purpose of subdividing those already instituted, as of adding others for other branches of science. To the professorships usually established in the universities of Europe, it would seem proper to add one for the ancient languages and literature of the north, on account of their connection with our own languages, laws, customs, and history. The purposes of the Brasserton institution would be better answered by maintaining a perpetual mission among the Indian tribes; the object of which, besides instructing them in the principles of Christianity, as the founder requires, should be to collect their traditions, laws, customs, languages, and other circumstances which might lead to a discovery of their relation to one another, or descent from other nations. When these objects are accomplished with one tribe, the missionary might pass on to another.

The college edifice is a huge, misshapen pile; "which, but that it has a roof, would be taken for a brick-kiln." In 1787, there were about thirty young gentlemen members of this college, a large proportion of which were law students.

The academy in Prince Edward county has been erected into a college by the name of Hampden Sydney college. It has been a flourishing seminary, but is now said to be on the decline.

Connecticut.—Yale College was founded in 1700, and remained at Killingworth until 1707; then at Saybrook until 1716, when it was removed and fixed at New Haven. Among its principal benefactors was Governor Yale, in honor of whom, in 1718, it was named Yale College. Its first building was erected in 1717, being one hundred and seventy feet in length, and twenty-two in breadth, built of wood. This was taken down in 1782. The present college, which is of brick, was built in 1750, under the direction of the Rev. President Clap, and is one hundred feet long and forty feet wide, three stories high, and contains thirty-two chambers, and sixty-four studies, convenient for the reception of one hundred students. The college chapel, which is also of brick, was built in 1761, being fifty feet by forty, with a steeple one hundred and twenty-five feet high. In this building is the public library, consisting of about two thousand five hundred volumes; and the philosophical apparatus, which, by a late handsome addition, is now as complete as most others in the United States, and contains the machines necessary for exhibiting experiments in the whole course of experimental philosophy and astronomy. The college museum, to which additions are constantly making, contains many natural curiosities.

This literary institution was incorporated by the General Assembly of Connecticut. The first charter of incorporation was granted to eleven ministers, under the denomination of trustees, in 1701. The powers of the trustees were enlarged by the additional charter of 1723. And by that of 1745, the trustees were incorporated by the name of "The president and fellows of Yale College, New Haven." By an act of the General Assembly "for enlarging the powers and increasing the funds of Yale College," passed in May, 1792, and accepted by the corporation, the governor, lieutenant-governor, and the six senior assistants in the council of the State for the time being, are ever hereafter, by virtue of their offices, to be trustees and fellows of the college, in addition to the former corporation. The corporation are empowered to hold estates, continue their succession, make academic laws, elect and constitute all officers of instruction and government usual in universities, and confer all learned degrees. The immediate executive government is in the hands of the president and tutors. The present officers and instructors of the college are, a president, who is also professor of ecclesiastical history, a professor of divinity, and three tutors. The number of students, on an average, is about 130, divided into four classes. It is worthy of remark, that as many as five-sixths of those who have received their education at this university, were natives of Connecticut.

The funds of this college received a very liberal addition by a grant of the General Assembly, in the act of 1792 before mentioned; which will enable the corporation to erect a new building for the accommodation of the students, to support several new professorships, and to make a handsome addition to the library.

The course of education in this university comprehends the whole circle of literature. The three learned languages are taught, together with so much of the sciences as can be communicated in four years.

In May and September, annually, the several classes are critically examined in all their classical studies. As incentives to improvement in composition and oratory, quarterly exercises are appointed by the president and tutors, to be exhibited by the respective classes in rotation. A public commencement is held annually on the second Wednesday in September, which calls together a more numerous and brilliant assembly, than are convened by any other anniversary in the State.

About two thousand two hundred have received the honors of this university, of whom nearly seven hundred and sixty have been ordained to the work of the gospel ministry.

[Wansey, in his *Journal of an Excursion to the United States of North America in* 1794, thus speaks of the college: I went over to the college, which stands in the market-place. It consist of two brick edifices, one hundred feet long and three stories high. It was founded in the year 1700; it was but in bad condition when I saw it; very dirty, particularly the library. The books were numerous, but very old and in bad condition; two large globes of Senex's, a large electrical apparatus, a good reflecting telescope, and a cabinet of curiosities, with which I was much entertained; viz., Indian helmets, curiously woven with feathers; warlike dresses and belts of wampum. Two large teeth of the mammoth, found on the banks of the Ohio, in the shape of human cheek teeth; I measured them with my handkerchief, and applied it to a foot rule, and found their dimensions to be twenty-two inches round horizontally, and twenty inches long when I measured longitudinally, over the tops and between the roots. The skins of two beautifully spotted snakes, eighteen feet long, from South America; an Indian calumet or pipe of peace; a young alligator, preserved in spirits; instruments of war and of fishing, from Nootka Sound. Cloth made at Otaheite. A curious frog, with a long tail like a lizard. Several pieces of asbestos found in that neighborhood. But what most particularly struck me, was a snake with two distinct heads; I asked the librarian whether this was not considered as a monster, a *lusus naturæ?* He assured me not, and that in that neighborhood they had often been found alive. This one was preserved in spirits, in size, color, and shape, like our *flow worm*, about eight or nine inches long; the two heads were of the same size, and every way perfect, branching off equally from the trunk, in opposite directions, one inch and a quarter in length. I afterwards saw at Philadelphia, in Peale's museum, two others of this sort, only that one of them had three heads; neither of them in a straight direction with the body. I did not see Dr. Stiles, the president of the college, he was gone to New York that day. The students had all been dismissed to their respective homes, three months before, on account of the epidemic or putrid fever which then raged in the town.]

New Jersey.—There are two colleges in New Jersey; one at Princetown, called Nassau Hall, the other at Brunswick, called Queen's College.

The college at Princetown was first founded by charter from John Hamilton, Esq., President of the Council, about the year 1738, and enlarged by Governor Belcher in 1747. The charter delegates a power of granting to "the students of said college, or to any others thought worthy of them, all such degrees as are granted in either of the universities, or any other college in Great Britain." It has twenty-three trustees. The governor of the State, and the president of the college are *ex officiis*, two of them. It has an annual income of about nine hundred pounds currency, of which two hundred pounds arise from funded public securities and lands, and the rest from the fees of the students.

The president of the college is also professor of eloquence, criticism and chronology. The vice-president is also professor of divinity and moral philosophy. There is also a professor of mathematics and natural philosophy, and two masters of languages. The four classes in college contain commonly from seventy to one hundred students. There is a grammar-school of about twenty scholars connected with the college, under the superintendence of the president, and taught sometimes by a senior scholar, and sometimes by a graduate.

Before the war, this college was furnished with a philosophical apparatus, worth five hundred pounds, which (except the elegant orrery constructed by Mr. Rittenhouse) was almost entirely destroyed by the British army in the late war, as was also the library, which now consists of between two and three thousand volumes.

The college edifice is handsomely built with stone, and is one hundred and eighty feet in length, fifty-four in breadth, and four stories high, and is divided into forty-two convenient chambers for the accommodation of the students, besides a dining-hall, chapel, and room for the library. Its situation is elevated, and exceedingly pleasant and healthful. It is remarkable, that since the removal of the college to Princetown, in 1756, there have been but five or six deaths among the students. The view from the college balcony is extensive and charming.

The college has been under the care of a succession of presidents, eminent for piety and learning, and has furnished a number of civilians, divines and physicians, of the first rank in America.

The charter for Queen's College, at Brunswick, was granted [1770] just before the war, in consequence of an application from a party of the Dutch church. Its funds, raised wholly by free donations, amounted, soon after its establishment, to four thousand pounds, but they were considerably diminished by the war. The grammar school, which is connected with the college, consists of between thirty and forty students, under the care of the trustees. The college at present is not in a very flourishing state.

New York.—Until the year 1745, there was no college in the province of New York. The state of literature, at that time, I shall give in the words of the state historian:* "Our schools are in the lowest order; the instructors want instruction, and through a long and shameful neglect of all the arts and sciences, our common speech is extremely corrupt, and the evidences of a bad taste, both as to thought and language, are visible in all our proceedings, public and private." This may have been a just representation at the time when it was written; but much attention has since been paid to education.

Kings College, in the city of New York, was principally founded by the voluntary contributions of the inhabitants of the province, assisted by the General Assembly, and the corporation of Trinity Church; in the year 1754, a royal charter (and grant of money) being then obtained, incorporating a number of gentlemen therein mentioned, by the name of "The Governors of the College of the Province of New York, in the city of New York, in America; and granting to them and their successors for ever, amongst various other rights and privileges, the power of conferring all such degrees as are usually conferred by either of the English universities.

By the charter it was provided that the president shall always be a member of the church of England, and that a form of prayer collected from the liturgy of that church, with a particular prayer for the college, shall be daily used, morning and evening, in the college chapel; at the same time, no test of their religious persuasion was required from any of the fellows, professors, or tutors; and the advantages of education were equally extended to students of all denominations.

The building, which is only one-third of the intended structure, consists of an elegant stone edifice, three complete stories high, with four stair cases, twelve apartments in each, a chapel, hall, library, museum, anatomical theatre, and school for experimental philosophy.

The college is situated on a dry, gravelly soil, about one hundred and fifty yards from the bank of Hudson's river, which it overlooks; commanding a most extensive and beautiful prospect (now solid warehouses).

Kings College is now called Columbia College. This college, by an act of the legislature passed in the spring of 1787, was put under the care of twenty-four gentlemen, who are a body corporate, by the name and style of "The Trustees of Columbia College in the city of New York." This body possess all the powers vested in the governors of Kings College before the revolution, or in the regents of the university since the revolution, so far as their power respected this institution. No regent can be a trustee of any particular college or academy in the State. The regents of the university have power to confer the higher degrees, and them only.

The college edifice has received no additions since the peace. The funds, exclusive of the liberal grant of the legislature, amount to between twelve and thirteen thou-

* Smith's History of New York, *London*, 1757.

sand pounds currency, the income of which is sufficient for present exigencies.

This college is now in a thriving state, and has about one hundred students in the four classes, besides medical students. The officers of instruction and immediate government are a president, professor of mathematics and natural philosophy, a professor of logic and geography, and a professor of languages. A complete medical school has been lately annexed to the college, and able professors appointed by the trustees in every branch of that important science, who regularly teach their respective branches with reputation. The number of medical students is about fifty, but they are increasing. The library and museum were destroyed during the war. The philosophical apparatus is new and complete.

[Union College, at Schenectady, received its charter from the Regents of the University in 1795, but owing to inadequate means and the short administrations of its first three presidents, John Blair Smith, Jonathan Edwards and Jonathan Marcy, the institution did not develope into a college until its administration was committed to Rev. Eliphalet Nott, at the time pastor of the Presbyterian church at Albany.]

Rhode Island.—At Providence is Rhode Island College. The charter for founding this seminary of learning was granted by the General Assembly of the State, by the name of the "Trustees and Fellows of the College or University, in the English colony of Rhode Island and Providence Plantations,"* in 1764, in consequence of the petition of a large number of the most respectable characters in the State. By the charter, the corporation of the college consists of two separate branches, with distinct, separate, and respective powers. The number of trustees is thirty-six, of whom twenty-two are Baptists, five of the denomination of Friends, five Episcopalians, and four Congregationalists. The same proportion of the different denominations to continue *in perpetuum*. The number of fellows (inclusive of the president, wh is a fellow *ex officio*) is twelve, of whom eight are Baptists, the others chosen indiscriminately from any denomination. The concurrence of both branches, by a majority of each, is necessary for the validity of an act, except adjudging and conferring degrees, which exclusively belongs to the fellowship as a learned faculty. The president must be a Baptist: professors and other officers of instruction are not limited to any particular denomination.

This institution was first founded at Warren, in the county of Bristol, and the first commencement held there in 1769.

In the year 1770, the college was removed to Providence, where a large, elegant building was erected for its accommodation, by the generous donations of individuals, mostly from the town of Providence. It is situated on a hill to the east of the town; and while its elevated situation renders it delightful, by commanding an extensive variegated prospect, it furnishes it with a pure, salubrious air. The edifice is of brick, four stories high, one hundred and fifty feet long, and forty-six wide, with a projection of ten feet each side. It has an entry lengthwise, with rooms on each side. There are forty-eight rooms for the accommodation of students, and eight larger ones for public uses. The roof is covered with slate.

From December, 1776, to June, 1782, the college edifice was used by the French and American troops for an hospital and barracks, so that the course of education was interrupted during that period. No degrees were conferred from 1776 to 1786. From 1786, the college again became regular, and is now very flourishing, containing upwards of sixty students.

This institution is under the instruction of a president, a professor of divinity, a professor of natural and experimental philosophy, a professor of mathematics and astronomy, a professor of natural history, and three tutors. The institution has a library of between two and three thousand volumes, containing a valuable philosophical apparatus. Nearly all the funds of the college are at interest in the treasury of the State, and amount to almost two thousand pounds.

Pennsylvania.—The University of Pennsylvania, by that name, was chartered in 1779 by an act which annulled the charter of the Academy and Charitable School, obtained by Franklin in 1749, and enlarged into a college in 1755. By an act of 1789 the trustees and faculty of the old college were reinstated, and by an act of 1791 the two institutions were united in the Univer-

* This name to be altered when any generous benefactor arises, who by his liberal donation shall entitle himself to the honor of giving the college a name.

sity of Pennsylvania. Winterbotham, writing in 1795, says: In Philadelphia is the University of Pennsylvania, founded and endowed by the legislature during the war. Professorships are established in all the liberal arts and sciences, and a complete course of education may be pursued here from the first rudiments of literature to the highest branches of science.

The college and academy of Philadelphia was founded by charter between thirty and forty years ago, and endowed by subscription of liberal minded persons. Though this institution was interrupted in its progress for several years during the late war, yet being re-established since the peace, it has rapidly recovered its former state of prosperity, and to the bench of professors has lately been added one of common and federal law, which renders it in reality, though not in name, an university. An act to unite these two institutions has passed the legislature. By their union they will constitute one of the most respectable seminaries of learning in the United States.

Dickinson College, at Carlisle, an hundred and twenty miles westward of Philadelphia, was founded in 1783, and has a principal, three professors, a philosophical apparatus, a library consisting of nearly three thousand volumes, four thousand pounds in funded certificates, and ten thousand acres of land; the last, the donation of the State. In 1787, there were eighty students belonging to this college: this number is annually increasing. It was named after his excellency John Dickinson, author of the Pennsylvania Farmer's Letters, and formerly president of the Supreme Executive Council of this State.

In 1787, a college was founded at Lancaster, sixty-six miles from Philadelphia, and honored with the name of Franklin college, after his excellency, Dr. Franklin. This college is for the Germans, in which they may educate their youth in their own language, and in conformity to their own habits. The English language, however, is taught in it. Its endowments are nearly the same as those of Dickinson College. Its trustees consist of Lutherans, Presbyterians, and Calvinists, of each an equal number. The principal is a Lutheran, and the vice-principal is a Calvinist.

Maryland.—In 1782, a college was instituted at Chestertown, in Kent county, and was honored with the name of Washington College, after President Washington. It is under the management of twenty-four visitors of governors, with power to supply vacancies and hold estates, whose yearly value shall not exceed six thousand pounds current money. By a law enacted in 1787, a permanent fund was granted to this institution of one thousand two hundred and fifty pounds a year, currency, out of the moneys arising from marriage licenses, fines, and forfeitures on the eastern shore.

St. Johns College was instituted in 1784, to have also twenty-four trustees, with power to keep up the succession by supplying vacancies, and to receive an annual income of nine thousand pounds. A permanent fund* is assigned this college, of one thousand seven hundred and fifty pounds a year, out of the moneys arising from marriage licenses, ordinary licenses, fines and forfeitures, on the western shore. This college is at Annapolis, where a building has been prepared for it. Very liberal subscriptions have been obtained towards founding and carrying on these seminaries. The two colleges constitute one university, by the name of "the University of Maryland," whereof the governor of the State for the time being is chancellor, and the principal of one of them vice-chancellor, either by seniority or by election, as may hereafter be provided for by rule or by law. The chancellor is empowered to call a meeting of the trustees, or a representation of seven of each, and two of the members of the faculty of each, the principal being one, which meeting is styled, "The Convocation of the University of Maryland," who are to frame the laws, preserve uniformity of manners and literature in the colleges, confer the higher degrees, determine appeals, &c.

The Roman Catholics have also erected a college at Georgetown, [included in the cession for the District of Columbia] on the Potomac river, for the promotion of general literature.

In 1785, the Methodists instituted a college at Abingdon, in Harford county, by the name of Cokesbury College, after Thomas Coke, and Francis Ashbury, *bishops* of the Methodist Episcopal Church. The college edifice is of brick, handsomely built on a healthy spot, enjoying a fine air, and a very extensive prospect.

The students, who are to consist of the

* Repealed by Legislature in 1804.


FOUNDING OF DARTMOUTH COLLEGE, IN 1769. *Engraved in* 1839.

sons of traveling preachers, of annual subscribers, of the members of the Methodist society and orphans, are instructed in English, Latin, Greek, Logic, Rhetoric, History, Geography, Natural Philosophy and Astronomy; and when the finances of the college will admit, they are to be taught the Hebrew, French, and German languages.

The college was erected, and is supported wholly by subscription and voluntary donations.

The students have regular hours for rising, for prayers, for their meals, for study, and for recreation: they are all to be in bed precisely at nine o'clock. Their recreations, (for they are to be "indulged in nothing which the world calls *play*,") are gardening, walking, riding, and bathing, without doors; and within doors, the carpenter's, joiner's, cabinet-maker's, or turner's business. Suitable provision is made for these several occupations, which are to be considered, not as matters of drudgery and constraint, but as pleasing and healthful recreations both for the body and mind. Another of their rules, which though new and singular, is favorable to the health and vigor of the body and mind, is, that the students shall not sleep on feather beds but on mattresses, and each one by himself. Particular attention is paid to the morals and religion of the students.

New Hampshire.—The establishment of Dartmouth College [founded by Eleazer Wheelock, D. D., in 1769, at Hanover, in Grafton county, with special view to the education of young Indians] in the western border of the State, has proved a great benefit to the new settlements, and to the neighboring State of Vermont. During the late war, like all other seminaries of literature, it lay under discouragement; but since the peace it is in a more flourishing situation.

Its landed interest amounts to about eighty thousand acres, of which twelve hundred lie contiguous, and are capable of the best improvement. Twelve thousand acres are situate in Vermont. A tract of eight miles square beyond the northern line of Stuart town, was granted by the Assembly of New Hampshire in 1789, and in the act by which this grant was made, "the president and council of the State for the time being are incorporated with the trustees of the college, so far as to act with them in regard to the expenditures and application of this grant, and of all others which have been or may be hereafter made by New Hampshire."

The revenue of the college arising from the lands, amounts to one hundred and forty pounds per annum. By contracts already made it will amount in four years to four hundred and fifty; and in twelve years to six hundred and fifty pounds. The income arising from tuition money is about six hundred pounds per annum more.

The first building erected for the accommodation of the students was a few years since burned. A lottery was granted by the State for raising the sum of seven hundred pounds, which has been applied to the erection of a new building, much more convenient than the former; it was constructed of wood, and stands in an elevated situation, about half a mile eastward of Connecticut river in the township of Hanover, commanding an extensive and pleasant prospect to the west. It is one hundred and fifty feet long, fifty feet wide, and thirty-six feet high, and contains thirty-six chambers for students. The number of students who were graduated in the first nineteen years, amounts to two hundred and fifty-two, among whom were two Indians. In the year 1790, the number of undergraduates was about one hundred and fifty.

The students are divided into four classes. The freshmen study the learned languages, the rules of speaking and writing, and the elements of mathematics.

The sophomores attend to the languages, geography, logic, and mathematics.

The junior sophisters, beside the languages, enter on natural and moral philosophy and composition.

The senior class compose in English and Latin; study metaphysics, the elements of natural and political law.

The principal books used by the students are Lowth's English Grammar, Perry's Dictionary, Pike's Arithmetic, Guthrie's Geography, Ward's Mathematics, Atkinson's Epitome, Hammond's Algebra, Martin's and Enfield's Natural Philosophy, Ferguson's Astronomy, Locke's Essay, Montesquieu's Spirit of Laws, and Burlemaqui's Natural and Political Law.

Besides these studies, lectures are read to the scholars in theology and ecclesiastical history.

Kentucky.—The legislature of Virginia, while Kentucky made a part of that State, made provision for a college in it, and endowed it with very considerable landed funds; and a library for its use was forwarded thither by the Rev. Mr. John Todd of Virginia, (after obtaining the consent of the Rev. Dr. Gordon) while an inhabitant of the Massachusetts State. This library was mostly formed in the following manner: An epistolary acquaintance having commenced between Mr. Todd and Dr. Gordon, through the influence of their common friend, the Rev. Mr. Samuel Davis, long since deceased, a letter was received about the end of 1764, or beginning of 1765, from Mr. Todd, in which he expressed a desire of obtaining a library and some philosophical apparatus, to improve the education of some young persons, who were designed for the ministry. Dr. Gordon being then settled at London, upon application obtained a few annual subscriptions, with several donations of money, and of books, which were not closed till after March, 1769. During that period he received in cash, including his own subscription, eighty pounds two shillings and sixpence. The late worthy John Thornton, Esq., contributed fifty pounds of it, by the hand of the Rev. Mr. (afterwards Dr.) Wilson, who also gave in books ten pounds. Among the contributors still living, beside Dr. Gordon himself, are the Rev. Mr. Towle, Messrs. Fuller, Samuel, and Thomas Statton, Charles Jerdein, David Jennings, Jonathan Eade, Joseph Ainsley, and John Field of Thames street.

Of the money collected, twenty-eight pounds ten shillings was paid to the late Mr. Ribright, for an air-pump, microscope, telescope, and prisms, thorough good, but not new. Cases, shipping, freight, insurance, &c., at four different periods, came to eight pounds eleven shillings and sixpence. The forty-three pounds one shilling was laid out to the best advantage in purchasing a variety of books, which, with those that were given, are supposed to make the main part of the Lexington Library.*

North Carolina.—The General Assembly of North Carolina, in December, 1789, passed a law incorporating forty gentlemen, five from each district, as trustees of the university of North Carolina; to this university they gave, by a subsequent law, all the debts due to the State from sheriffs or other holders of public money, and which had been due before the year 1783; they also gave it all escheated property within the State. Whenever the trustees shall have collected a sufficient sum of the old debts, or from the sale of escheated property, the value of which is considerable, to pay the expense of erecting buildings, they are to fix on a proper place, and proceed in the finishing of them; a considerable quantity of land has already been given to the university, and the General Assembly, in December, 1791, loaned five thousand pounds to the trustees, to enable them to proceed immediately with the buildings.

[The first college edifice was opened at Chapel Hill for the reception of students in Feb., 1795, under the faculty composed of Rev. David Kerr, of Trinity College, Dublin; Professor C. H. Harris, in the mathematical chair, a graduate of Princeton, and Prof. Joseph Caldwell, a native of New Jersey and a graduate of Princeton, in 1791. The latter was elected the first president in 1804.]

South Carolina.—Gentlemen of fortune, before the late war, sent their sons to Europe for education. During the late war and since, they have generally sent them to the middle and northern States. Those who have been at this expense in educating their sons, have been but comparatively few in number, so that the literature of the State is at a low ebb. Since the peace, however, it has begun to flourish. There are several respectable academies at Charleston; one at Beaufort, on Port Royal Island; and several others in different parts of the State. Three colleges have lately been incorporated by law; one at Charleston, one at Winnsborough, in the district of Camden, and the other at Cambridge, in the district of Ninety-six. The public and private donations for the support of these three colleges were originally intended to have been appropriated jointly, for the erecting and supporting of one respectable college. The division of these donations has frustrated this design. Part of the old barracks in Charleston has been handsomely fitted up, and converted into a college, and there are a number of students; but it does not yet merit a more dignified name than that of a respectable academy. The Mount Sion college, at Winnsborough, is supported by a respectable society of gentlemen, who have long been incorporated. This institution flourishes, and bids fair for usefulness. The college at

* As this account of the library is essentially different from that given by Mr. Morse, and every other writer we have met with, the editor thinks it right to inform the public, that he inserts the above at the desire of the Rev. Dr. Gordon himself.

Cambridge is no more than a grammar school.

[The college at Charleston graduated its first class in 1794, but its organic connection with the grammar school repressed its growth to meet the wants of a collegiate education, which was soon liberally provided for in the South Carolina College, chartered by the State in 1801, and was ever afterwards the favorite institution with both the legislature and the people.]

Georgia.—The charter, containing their present system of education, was passed in the year 1785. A college, with ample and liberal endowments, is instituted in Louisville, a high and healthy part of the country, near the centre of the State. There is also provision made for the institution of an academy in each county in the State, to be supported from the same funds, and considered as parts and members of the same institution, under the general superintendence and direction of a president and board of trustees, appointed, for their literary accomplishments, from the different parts of the State, invested with the customary powers of corporations. The institutions thus composed and united is denominated, "The University of Georgia."

That this body of literati, to whom is intrusted the direction of the general literature of the State, may not be so detached and independent, as not to possess the confidence of the State; and, in order to secure the attention and patronage of the principal officers of government, the governor and council, the speaker of the House of Assembly, and the chief justice of the State, are associated with the board of trustees, in some of the great and more solemn duties of their office, such as making the laws, appointing the president, settling the property, and instituting academies. Thus associated, they are denominated, "The Senate of the University," and are to hold a stated, annual meeting, at which the governor of the State presides.

The Senate appoint a board of commissioners in each county, for the particular management and direction of the academy, and the other schools in each county, who are to receive their instructions from, and are accountable to the Senate. The rector of each academy is an officer of the university, to be appointed by the president, with the advice of the trustees, and commissioned under the public seal, and is to attend with the other officers at the annual meeting of the Senate, to deliberate on the general interests of literature, and to determine on the course of instruction for the year, throughout the university. The president has the general charge and oversight of the whole, and is from time to time to visit them, to examine into their order and performances.

The funds for the support of their institution are principally in lands, amounting in the whole to about fifty thousand acres, a great part of which is of the best quality, and at present very valuable. There are also nearly six thousand pounds sterling in bonds, houses, and town lots in the town of Augusta. Other public property to the amount of one thousand pounds in each county, has been set apart for the purposes of building and furnishing their respective academies.

[Vermont.—In the first organization of the State, in 1777, the constitution of Vermont enjoined on the Legislature the founding of a University. In 1785 the Legislature responded to a call from Dartmouth for aid, by a grant of a township of land to that institution. In 1791 the charter of a State University was granted in furtherance of a donation of land by Ira Allen in 1789; a president was elected with a salary of $600, a professor of mathematics with a salary of $350, and a tutor with $300, and from a prospectus issued at the time it was calculated that a poor scholar, by keeping school six months each winter at the average price of $16, could pay his college bills and board, and leave college with $32 in his pocket. The college asked only $12 a year for each student. Small as this sum was, there were academies in the State which claimed to give as good opportunities for the scholarship required by the times, at as low, or at a lower rate, and allow the students to reside at home.

Middlebury College was chartered in 1800, and between the two institutions a local rivalry sprung up, which at times passed into belligerent legislation, and at no time rested simply on offering a better article of collegiate culture to the young aspirants of science.]

To the above account by Winterbotham, of the number, and general organization and condition of American colleges prior to 1800, we shall, as in the case of Common Schools and Academies, throw light on the instruction and discipline which prevailed in them from the communications of students.

(2.) *College Studies and Discipline about* 1800.

Judge Story, in a letter respecting the studies and discipline at Harvard between 1794 and 1798, writes in 1840:

"You express a desire to obtain some general views of the circumstances under which the students lived. I believe that this can be best done by giving you a brief sketch of the state of college, and the relation which the students had with the existing college government. Things are so much changed since that it is somewhat difficult to realize all the influences which then surrounded them. In the first place as to the course of studies. It was far more confined and limited than at present. In Greek we studied Xenophon's Anabasis and a few books of the Iliad; in Latin, Sallust and a few books of Livy; in Mathematics, Saunderson's Algebra and a work on Arithmetic; in Natural Philosophy, Enfield's Natural Philosophy and Ferguson's Astronomy; in Rhetoric, an abridgment of Blair's Lectures and the article on Rhetoric in the 'Preceptor'; in Metaphysics, Watt's Logic and Locke on the Human Understanding; in History, Millot's Elements; in Theology, Doddridge's Lectures; in grammatical studies, Lowth's Grammar. I believe this is near the whole, if not the whole, course of our systematical studies. The college library was at that time far less comprehensive and suited to the wants of students than at present. It was not as easily accessible, and, indeed, was not frequented by them. No modern language was taught except French, and that only one day in the week by a non-resident instructor.

"The means of knowledge from external sources was very limited. The intercourse between us and foreign countries was infrequent, and I might almost say that we had no means of access to any literature and science except the English. Even in respect to this we had little more than a semi-annual importation of the most common works, and a few copies supplied and satisfied the market. The English periodicals were then few in number, and I do not remember any one that was read by the students except the Monthly Magazine (the old Monthly), and that was read but by a few. I have spoken of our semi-annual importations, and it is literally true, that two ships only plied as regular packets between Boston and London, one in the Spring and one in the Autumn, and their arrival was an era in our college life.

"In respect to academical intercourse the students had literally none that was not purely official, except with each other. The different classes were almost strangers to each other, and cold reserve generally prevailed between them. The system of 'fagging' (as it was called) was just then dying out, and I believe that my own class was the first that was not compelled to perform this drudgery at the command of the Senior class in the most humble services. The students had no connection whatsoever with the inhabitants of Cambridge by private social visits. There was none between the families of the president and professors of the college and the students. The *régime* of the old school in manners and habits then prevailed. The president and professors were never approached except in the most formal way, and upon official occasions; and in the college yard (if I remember rightly) no student was permitted to be with his hat on if one of the professors was there."

The system of fagging to which Judge Story alludes was one of the *barbarisms* which prevailed in the old medieval universities,* and which still prevails in the "public schools," the great endowed boarding schools of England, from which our fathers introduced it into the American college. In the laws for the government of Yale College, printed in Latin, in 1764, were appended in good plain Saxon English a code of college customs, entitled FRESHMAN LAWS, as follows:

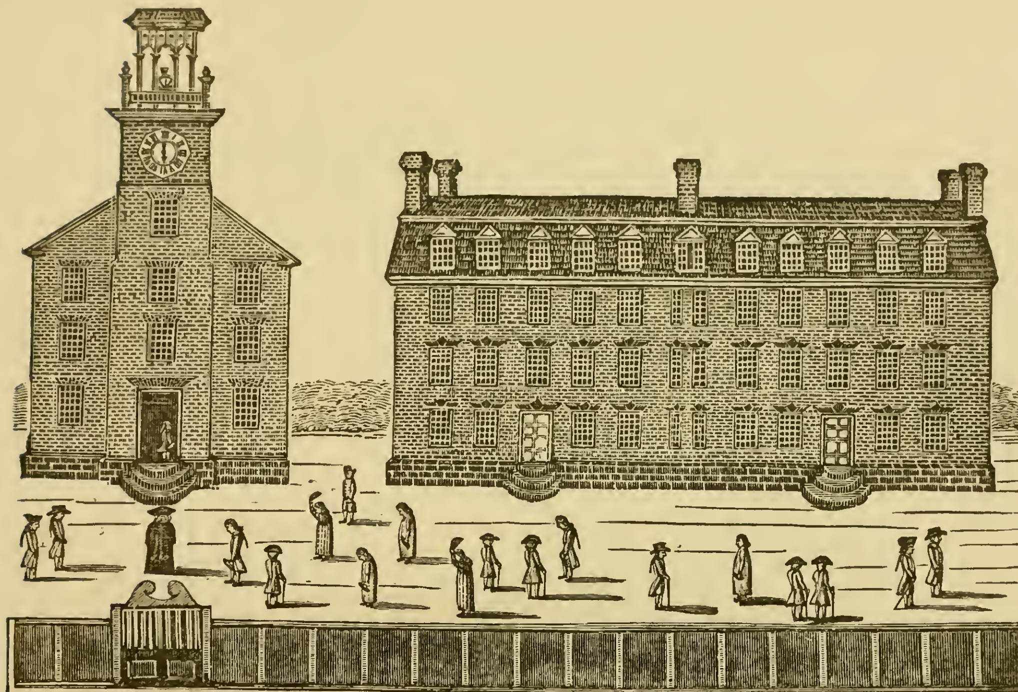
"It being the duty of the Seniors to teach Freshmen the laws, usages and customs of the college, to this end they are empowered to order the whole Freshman class, or any particular member of it, in order to be instructed or reproved, at such time and place as they shall appoint; when and where every Freshman shall attend, answer all proper questions, and behave decently. The Seniors, however, are not to detain a Freshman more than five minutes after study-bell, without special order from the President, Professor, or Tutor.

"The Freshmen, as well as all other undergraduates, are to be uncovered, and are forbidden to wear their hats (unless in stormy weather) in the front door-yard of the President's or Professor's house, or within ten rods of the person of the President, eight rods of the Professor, and five rods of a Tutor.

"The Freshmen are forbidden to wear their hats in college yard (except in stormy weather, or when they are obliged to carry something in their hands), until May vacation; nor shall they afterwards wear them in college or chapel.

"No Freshman shall wear a gown, or walk with a cane, or appear out of his room, without being

* See Barnard's "*Superior Education in different countries—Medieval Universities*, 1873."



YALE COLLEGE IN 1764.

completely dressed, and with his hat; and whenever a Freshman either speaks to a superior, or is spoken to by one, he shall keep his hat off, until he is bidden to put it on. A Freshman shall not play with any members of an upper class, without being asked; nor is he permitted to use any acts of familiarity with them, even in study-time.

"In case of personal insult, a Junior may call up a Freshman and reprehend him. A Sophomore in like cases must obtain leave from a Senior, and then he may discipline a Freshman, not detaining him more than five minutes, after which the Freshman may retire, even without being dismissed, but must retire in a respectful manner.

"Freshmen are obliged to perform all reasonable errands for any superior, always returning an account of the same to the person who sent them. When called, they shall attend and give a respectful answer; and when attending on their superior, they are not to depart until regularly dismissed. They are responsible for all damage done to any thing put into their hands, by way of errand. They are not obliged to go for the undergraduates in study-time, without permission obtained from the authority; nor are they obliged to go for a graduate out of the yard in study-time. A Senior may take a Freshman from a Sophomore, a Bachelor from a Junior, and a Master from a Senior. None may order a Freshman in one play-ground, to do an errand in another.

"When a Freshman is near a gate or door, belonging to college or college yard, he shall look around, and observe whether any of his superiors are coming to the same; and if any are coming within three rods, he shall not enter without a signal to proceed. In passing up or down stairs, or through an entry or any other narrow passage, if a Freshman meets a superior, he shall stop and give way, leaving the most convenient side—if on the stairs the banister side. Freshmen shall not run in college yard, or up or down stairs, or call to any one through a college window. When going into the chamber of a superior, they shall knock at the door, and shall leave it as they find it, whether open or shut. Upon entering the chamber of a superior, they shall not speak until spoken to; they shall reply modestly to all questions, and perform their messages decently and respectfully. They shall not tarry in a superior's room, after they are dismissed, unless asked to sit. They shall always rise whenever a superior enters or leaves the room where they are, and not sit in his presence until permitted.

"These rules are to be observed not only about college, but every where else within the limits of the city of New Haven."

Even so late as in 1800, we still find it laid down as the Senior's duty to inspect the manners and customs of the lower classes, and especially of the Freshmen; and the duty of the latter to do any proper errand, not only for the authorities of the college, but also within the limits of one mile, for resident graduates and for the two upper classes. By degrees the old usage sank down so far, that what the laws permitted was frequently abused for the purpose of playing tricks upon the inexperienced Freshmen; and then all evidence of its ever having been current disappeared from the college code. The Freshmen were formally exempted from the duty of running upon errands in 1804.

That these provisions were not peculiar to Yale, but belonged to this class of institutions in that and an earlier age, appears from the earliest laws for the government of Harvard College drawn up by President Dunstan in 1640. "They (the students) shall honor, as their parents, the magistrates, elders, trustees, and all who are older than themselves, as reason requires, being silent in their presence, except when asked a question, not contradicting, but showing all those marks of honor and reverence which are in praiseworthy use, saluting them with a bow, standing uncovered," &c. The mode of discipline authorized by the seventeenth rule is a recorded proof of what otherwise might have rested on obscure traditions only, that our fathers, with their cotemporaries generally, were not well informed upon the characteristics of human nature and heart. "If any student of this college, either from perverseness or from gross negligence, after he shall have been twice admonished, he shall be scourged with rods, if not an adult; but if an adult, his case shall be taken before the overseers, that notice may be publicly taken of him according to his deserts." "No scholar shall taste tobacco, unless permitted by the president, with the consent of their parents or guardians, or on good reason first given by a physician, and then in a sober and private manner." "None shall pragmatically intrude, or intermeddle in other men's affairs."

Mr. Everett in an address at Cambridge, in 1857, gives the following picture of college life as it was at Harvard in 1807:

"Let me sketch you the outlines of the picture, fresh to my mind's eye as the image in the *camera*, which the precincts of the college exhibited in 1807. The Common was then uninclosed. It was not so much traversed by roads in all directions; it was at once all road and no road at all,—a waste of mud and of dust, according to the season, without grass, trees, or fences. As to the streets in those days, the 'Appian Way' existed then as now; and I must allow that it bore the same resemblance then as now to the *Regina Viarum*, by which the consuls and proconsuls of Rome went forth to the conquest of Epirus, Macedonia, and the East.

"As to public buildings in the neighborhood of the university, with the exception of the Episcopal church, no one of the churches now standing was then in existence. The old parish church has disappeared, with its square pews, and galleries from which you might almost jump into the pulpit. It occupied a portion of the space between Dane Hall and the old Presidential House. I planted a row of elm and oak trees a few years ago on the spot where it stood, for which, if for nothing else, I hope to be kindly remembered by posterity. The wooden building now used as a gymnasium, and, I believe for some other purposes, then stood where Lyceum Hall now stands. It was the county court-house; and there I often heard the voice of the venerable Chief Justice Parsons. Graduates' Hall did not exist; but on a part of the site, and behind the beautiful linden trees still flourishing, was an old black wooden house, the residence of the professor of mathematics. A little further to the north, and just at the corner of Church street, which was not then opened, stood what was dignified in the annual college catalogue (which was printed on one side of a sheet of paper, and was a novelty) as 'The College House.' The cellar is still visible. By the students this edifice was disrespectfully called 'Wiswall's Den,' or, for brevity, 'the Den.' I lived in it in my freshman year. Whence the name of 'Wiswall's Den' was derived, I hardly dare say; there was something worse than 'old fogy' about it. There was a dismal tradition that, at some former period, it had been the scene of a murder. A brutal husband had dragged his wife by the hair up and down the stairs, and then killed her. On the anniversary of the murder—and what day that was no one knew—there were sights and sounds—flitting garments draggled in blood, plaintive screams, *stridor ferri tractæque catenæ*—enough to appall the stoutest sophomore. But, for myself, I can truly say, that I got through my freshman year without having seen the ghost of Mr. Wiswall or his lamented lady. I was not, however, sorry when the twelvemonth was up, and I was transferred to the light, airy, well-ventilated room, No. 20 Hollis; being the inner room, ground-floor, north entry of that ancient and respectable edifice.

"Such was the physical aspect of things within the university. With the exception of a medical department, of which the germ only existed, all the professional schools have been added since my graduation; and within the college proper the means of education have been multiplied, and the standard of attainment raised in full proportion to the progress of the country in all other respects. When I entered college, four tutors and three professors formed the academic *corps*,—men never to be mentioned but with respect and gratitude; but composing an inadequate faculty, compared with the numerous and distinguished body by which instruction is now dispensed. There was no instruction in any of the modern languages, except in French to those who chose to pay for it. The professors were those of divinity, mathematics, and Hebrew; and this venerable language was, I think, required to be studied by every student whatsoever his destination in life. A classmate of mine used to beat us all in this department, though I believe it sometimes happened to him to get hold of the wrong line in the Latin translation at the bottom of the page in the Hebrew psalter, and so made a misfit all the way down. I do not hesitate to assure our younger brethren that they enjoy far greater advantages in the means and encouragements to improvement, and more important than any other, a far higher standard of excellence than were ever enjoyed by their fathers. And this in any department of knowledge, in the study of the ancient and modern languages, in exact science, the kingdoms of nature, in ethics, and the philosophy of mind."

Dr. Dwight, in a letter written in 1813, and included in his Travels in New England and New York, published in 1822, gives the following summary of collegiate and superior education in New England in 1812:

The eight Colleges of New England are located and designated as follows:

Harvard College, now styled the University, in Cambridge.

Yale College, at New Haven, in Connecticut.

Dartmouth College, at Hanover, in New Hampshire.

Brown University, at Providence, Rhode Island.

Williams College, at Williamstown, Massachusetts.

The University of Vermont, at Burlington in that State.

Middlebury College, at Middlebury in the same State, and

Bowdoin College, at Brunswick in the District of Maine.

You observe that some of these seminaries are styled Universities, and some of them Colleges. You will not from this suppose that the name University indicates any superior importance, or any more extensive scheme of education. The University at Cambridge, is, in some respects, the most considerable; and in every respect the University of Vermont is the least of all these literary establishments.

The state of these institutions in the year 1812, was the following:

THE UNIVERSITY OF CAMBRIDGE. — A President; seven Professors Academical; seven Professors Medical; three Tutors; a Librarian; a Regent; a Proctor; an instructor in the French language.

*The Academical Professors are,*

Of Theology; of Logic, Metaphysics, and Ethics; of Rhetoric and Oratory; of the Hebrew, other Oriental, and English languages; of Latin; of Mathematics and Natural Philosophy; of Greek; and of Natural History.

*The three Tutors teach,*

The senior Tutor, Geography, Geometry, Natural Philosophy and Astronomy; the second, Greek; and the third, Latin.

*Of the Medical Professorships,*

The first is of Anatomy and Surgery; the second, of the Theory and Practice of Medicine; the third, of Chemistry and the Materia Medica; and the fourth, of Clinical Medicine.

The two remaining ones are Assistants, or Adjuncts, to that of Anatomy and Surgery, and that of Chemistry, and the Materia Medica.

The number of students the same year, was 281.

YALE COLLEGE. — A President; five Professorships Academical; and three Medical.

*The Academical Professorships are,*

Of Theology; of Law, Natural and Political; of Mathematics and Natural Philosophy; of Chemistry and Mineralogy; and of Languages and Ecclesiastical History.

*The Medical, are*

Of Anatomy and Surgery; of the Theory and Practice of Physic; and of the Materia Medica and Botany.

Here also is one Professorship adjunct.

*Six Tutors.*

The particular provinces of these Instructors have been sufficiently explained; [two assigned to each of three lower classes, to conduct the three daily recitations in each.]

The number of students was 313.

DARTMOUTH COLLEGE. — A President; five Professorships Academical; one Medical; and two Tutors.

*The Academical Professorships, are*

Of Theology; of Civil and Ecclesiastical History; of Mathematics, and Natural Philosophy; of Languages; and of Chemistry.

*The Medical Professorship, is*

Of Medicine.

The number of students was about 150.

The number of Medical students, exceeded 50.*

* By the Catalogue of 1821, the number of students in Dartmouth College, was

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|---|---|
| Under Graduates | 157 |
| Resident do | 8 |
| Medical Students | 65 |

BROWN UNIVERSITY IN 1811.—A President; three Professorships Academical; and two Medical.

*The Academical Professorships, are*

Of Law, of Moral Philosophy, and Metaphysics; and of Chemistry.

*The Medical Professorships, are*

Of Anatomy, and Surgery; and of the Materia Medica, and Botany.

Two Tutors; and a Preceptor of a Grammar school, connected with the University.

The number of students was 128.

WILLIAMS COLLEGE.—A President, a Vice-President; a Professor of Mathematics, and Natural Philosophy; two Tutors.

The number of students was 95.

MIDDLEBURY COLLEGE, 1812. — A President; three Academical Professors.

One of Law; one of Mathematics and Natural Philosophy; one of Languages; two Tutors.

The number of students was 113.

UNIVERSITY OF VERMONT.—A President; a Profes- of Mathematics and Natural Philosophy; a Professor of the Learned Languages; a Medical Professor.

There are also four other Professorships on paper.

The number of students from 30 to 40.

The means of medical instruction in New England will be seen sufficiently in this account of its seminaries.

The Law School, heretofore mentioned in the description of Litchfield, as being under the instruction of Judge Reeve and James Gould, Esquire, would not, it is believed, do discredit to any country. Law is here taught as a science; and not merely, nor principally, as a mechanical business; not as a collection of loose, independent fragments, but as a regular, well-compacted system. At the same time the students are taught the practice by being actually employed in it. A court is constituted; actions are brought, and conducted through a regular process; questions are raised, and the students become advocates in form.

Students resort to this school from every part of the American Union. The number of them is usually about 40.

Every Theological Professor in these Seminaries is destined to instruct such students as apply to him in the science of Theology. But the Theological Seminary at Andover has already engrossed most of the young men in New England, designed for the desk. Three Professors, one of Theology, one of Sacred Literature, and one of Sacred Rhetoric, are already established here; and two or three more will probably be added to their number within a short time. Fifty students may be considered as the average number for three years past. As this Seminary is richly endowed, and as the gentlemen employed in its instruction, are pursuing their business with spirit and vigor, there are the best reasons to believe that it will hold a high rank among institutions of the same nature.

There are, also, in New England the following Medical societies:

The Massachusetts Medical Society.

The Connecticut Medical Society.

The New Hampshire Medical Society.

The objects of these institutions are to unite the gentlemen of the Faculty in friendship, and in one common pursuit of medical science; to discourage by their united influence empiricism in every form; to furnish a centre of correspondence for the reception and publication of medical discoveries; and, universally, to elevate and improve the art of healing.

A Historical Society was formed at Boston in the year 1791, and incorporated in the year 1794, by the name of the Massachusetts Historical Society. The object of this institution is to collect and publish whatever authentic documents may illustrate the past and present state of this country. Twelve volumes of its collections for this purpose have been already published; which in a very honourable manner prove the utility of the design.

An Agricultural Society has been formed in Connecticut, and another in Massachusetts. A small collection of papers, published by each, has been favorably received.

There are, also, two Philosophical Societies in New England. The American Academy of Arts and Sciences in Massachusetts, which holds its sittings at Boston; and the Connecticut Academy of Arts and Sciences, which meets in New Haven. The latter was incorporated in the year 1800. The American Academy has published three volumes. The Connecticut Academy has completed one volume of Memoirs, and also has begun the publication of a statistical account of the State. Both of these institutions are, it is believed, advancing.

I have here given you a summary, and, as I believe, an exact account of the means provided and employed for the purpose of diffusing literature, science, and general information among the inhabitants of New England.

It ought, however, to be added, that in a great part of the towns and parishes, there are social libraries established. In some places they are considerable; and in all, are of material use to the little circles in which they exist. The information which they spread is of importance. They also excite a disposition to read, and this employment naturally becomes a substitute for trifling, vicious, and gross amusements. It also contributes to render society, and its intercourse, in a good degree, intelligent and refined, while thought takes place of sense and passion; civility, of coarseness; and information, of scandal. It also enables parents to give their children better instruction, and to govern them more rationally, and at the same time it renders the children more dutiful and more amiable.

In this brief historical survey of the American College and University, founded on cotemporaneous exposition, coupled with other facts which can not here be presented for want of space in such a summary, it appears that:

1. The main purpose set forth in their foundation was "the glory of God," "Christ and the Church," "the upholding of the Protestant religion by a succession of a learned and orthodox ministry," and "the qualifying youth for public employment in church and civil state." To this end all the earlier colleges were avowedly denominational, and all the later (except a few based on the national land grants, or on large individual endowments), are practically denominational in the constitution of the governing body by which the teachers are appointed and the departments and subjects of instruction determined.

2. The instruction of the colleges, even the oldest and best, down to 1800 was given by the president and at most two professors, and two assistants, in theology (dogmatic and practical), the Latin and Greek grammars, and a little reading of Latin authors and less of Greek, a little geography, arithmetic, geometry, and logic, with disputations and declamations, and no natural science.

3. Gradually the curriculum of instruction was modified so as to drop the elementary studies, and include medicine and law, first by special professorships, and then by independent schools.

4. Still later, and recently with amazing rapidity, the natural sciences, and the application of mathematics and these sciences to agriculture the mechanic arts and manufacturing purposes, have been recognized as legitimate subjects of college education.

5. Quite recently the entire circle of language, science, and the arts both ideal and industrial, are included in the curriculum of several colleges; but as yet there is not a single institution out of the 400 so called colleges and universities chartered and endowed for purposes of superior instruction, in which the governing board and teaching corps are brought into unity of organization, administration, and instruction, and in which a broad sweep of optional studies in every department of existing knowledge and original research is open to those, and to those only, who shall prove themselves qualified before an independent board of examination to enter on such studies.

6. Following the course of secondary schools, the advantages of superior instruction are now beginning to be opened to both sexes on equal terms.

The tables appended will show, not strictly speaking, only our institutions of superior instruction, and not quite all which call themselves colleges and universities; but nearly all which are chartered by the legislatures of the States in which they are located "to confer the usual academic, collegiate and university degress." Most of them should be classed with institutions of secondary instruction.

## IV. PROFESSIONAL AND SPECIAL EDUCATION.

### INTRODUCTION.

Professional and Special Schools constitute a distinct class of institutions either in the studies pursued, or the persons pursuing, and while they are not always supplementary to the colleges, and indeed some of them hardly supplementary to the secondary schools, they can not with propriety be considered except by themselves. Under this head we specify Military, Theological, Medical, and Law Schools; Normal Schools, and Teachers' Institutes; Agricultural, and Commercial, or Business Colleges and Schools; Scientific Schools, *i. e.*, for instruction in physical science, applied mathematics, Organic and Inorganic Chemistry, Practical Surveying, Natural History, Geology and Palæontology, Anthropology, and Ethnology; as well as schools of Language and Literature, *i. e.*, Philology, Linguistics, Oriental and Semitic languages and Literature, Modern languages and Literature; History, Political Economy, Ethics, and International Law; Schools of Engineering, Mining, Metallurgy, Technology and Architecture; Schools of Drawing, Painting, Sculpture, and Music; Schools and Asylums for Orphans; Schools and Colleges for Indians and Freedmen; Philanthropic Schools and Asylums, viz., for the Deaf and Dumb, the Blind, and the Idiotic, and with some reference also to attempts to instruct the Insane and the Inebriates; and finally to Schools and Asylums for Juvenile offenders

Numerous as the special schools and institutions now are in this country, numbering in all very nearly 1,000, they have all, with a single exception of a Medical School in Philadelphia, been organized within the past hundred years, and with but few exceptions since the commencement of the present century, and the most important in the past half century. We will consider them in the order given above.*

### I. MILITARY AND NAVAL SCHOOLS.

The experience of the Revolutionary war occasioned a very general conviction among the officers of the American army, of the necessity for such a provision for the military education of native officers as would relieve the United States from a dependence upon professionally trained soldiers of foreign birth. The idea of a military school of some kind, to be connected with each United States arsenal, was entertained at the close of the war, among the officers.

In the spring of 1783, General Washington requested from a number of leading officers, statements of their views on all subjects connected with the peace establishment of the United States army. In reply to this request, Colonel Timothy Pickering, then quartermaster-general, drew up an able and interesting memoir, which contains, it is believed, the first suggestion of a single central government military academy, and he also suggested West Point as a proper location for it.

President Washington's annual address to Congress of December 3, 1793, asks "whether a material feature in the improvement of a system of national defense ought not to be to afford an opportunity for the study of those branches of the military art, which can scarcely ever be attained by practice alone."

An act of Congress of May 9, 1794, authorized a corps of four battalions of artillerists and engineers, to each of which were to be attached eight cadets. This was the first introduction into the military service of the United States of this term, which may be defined to signify a grade of officers between the highest non-commissioned officer, a sergeant, and the lowest commissioned one, an ensign. For the use of this corps and cadets, the secretary of war, Colonel Pickering, was authorized to procure the necessary books and apparatus. The secretary, in 1796, reports that this organization is important, and should be as stationary as practicable, with a view to instruction.

President Washington's last annual speech to Congress, December, 1796, again urged strongly the establishment of a military academy. In April, 1798, the corps of artillerists and engineers was increased by an additional regiment, and the number of cadets enlarged to fifty-six. In July following, four teachers were by Congress authorized to be employed in that regiment for instruction in science and art. Some officers and men were collected at West Point, and a sort of military school opened, which, however, acted with little efficiency, owing to the want of preparatory training, and of organization.

Secretary of War McHenry, in a report

* For details, see Barnard's *Special Schools*, Vol. II., United States.

on the organization of the army, made during the expectation of a war with France, dated December 24, 1798, lamented the want of engineers and artillerists trained at home. In January, 1800, the same officer laid before the President, who transmitted it to Congress, a plan for establishing a military academy. After referring to the imperfect steps already taken in this direction, he proceeds to suggest that the proposed academy shall consist of a "fundamental school," to instruct in such departments of science as are necessary in common in all the arms of the military force; and three special schools, one of engineers and artillerists, one of cavalry and infantry, and one of the navy. The institution was to be in charge of a director-general, four directors, twelve professors, and nine other instructors. This school, so far as Secretary McHenry recommended its immediate establishment, was to accommodate annual classes of one hundred pupils each, for courses of four and five years.

(1.) *Military Academy at West Point.*

The Military Academy at West Point, according to Colonel Williams' report in 1808, was first opened in 1801, as a "mathematical school for the few cadets that were then in service," and under a private citizen. In 1802, an act of Congress separated the artillerists and engineers, distributing the cadets of the former class among the twenty companies of that arm, and constituted the engineers the Military Academy, making it consist of seven officers and ten cadets.

The operations of the school continued to be deficient in order and efficiency for some years, mainly from want of proper and energetic administration, and a well-adjusted course of study. In 1812, it was much enlarged, and its organization quite changed. The period from 1817 to 1824, however, during which a thorough course of theoretical and practical studies, properly adapted to the military profession, was for the first time introduced, marks the establishment of the academy as a military and scientific school of high grade and value. There have been several modifications of the course of studies and regulations since 1818, increasing the studies, and raising somewhat the standard of admission which is still, however, too low. In 1859, the course of study was extended to five years, and the classes which graduated in 1859, 1860, and May, 1861, received five years instruction. But the exigencies of the war demanded a larger number of young officers who had a military training, and accordingly the class next in order were graduated in June, 1861, and since that time the course of study has been only four years. The superintendent of the academy is always an officer of not lower rank than colonel, a graduate of the academy who had ranked high on his graduation, and who has seen much active service. Beside the superintendent there were, in 1872, 49 professors, instructors and other officers employed in the work of instruction. The Academic Board is composed of twelve —ten professors, and the superintendent and commandant of cadets.

The number of cadets who may be appointed annually is one from each Congressional district and territory, and ten appointed by the President, at large. The applicants must not be under seventeen or over twenty-one years, (except volunteers or regulars in the late war who had served faithfully not less than one year, who are eligible till they are twenty-five. All applicants must be unmarried, and are not allowed to marry before graduation. Each candidate must be able to read and write the English language correctly, and to perform with facility and accuracy the various operations of the four ground rules of arithmetic, of reduction, of simple and compound proportion, and of vulgar and decimal fractions; and have a knowledge of the elements of English grammar, of descriptive geography, particularly of the United States of America, and of the history of the United States. They are examined in June, but are not admitted to full cadetship until the following January, when they are required to sign an agreement that they will serve in the army of the United States for eight years, unless sooner discharged by competent authority, and take the following oath, the phraseology of which has been somewhat modified since the commencement of the late civil war: "I solemnly swear that I will support the Constitution of the United States, and bear true allegiance to the National Government; that I will maintain the sovereignty of the United States, paramount to any and all allegiance, sovereignty, or fealty I may owe to any State, county, or country whatsoever; and that I will at all times obey the loyal orders of my superior officers, and the rules and articles governing the armies of the United States." The allowance to the cadet by the Government is about $610 per annum, which is all paid out by the Treasurer of the academy, and charged to the cadets, no money being allowed in the hands of the cadets during the entire course. The regulations are very rigid, and while about 28 per cent. of the applicants for admission are rejected, the the demerit system which regulates the class-standing of the cadet results in the dismission of nearly forty per cent. in the four years.

(2.) *The United States Naval Academy.*

After years of agitation in Congress, going back to the Continental Congress of 1775, and the recommendations of nearly every President, and the secretary in charge of naval affairs, the Naval Academy at Annapolis, Maryland, was organized in October, 1845, by the efforts of Hon. George Bancroft, then Secretary of the Navy.* Prior to the letter of Mr. Bancroft, which concentrated all the midshipmen then attached to vessels at sea under a schoolmaster, or collected at the Naval Asylums at Philadelphia, or stationed in the Navy-yards of Boston, New York, and Norfolk, much was done to familiarize the young aspirants with the practical duties of their profession. During the infancy of the academy several plans of an experimental character were tried, which led gradually to the adoption of the system of instruction now in operation. Midshipmen who had made a cruise at sea, were first sent to the academy for a term of nine months, to prepare for their final examination, which practice was continued until 1847. In that year a board of officers recommended a course of four years at the academy, viz., two years before, and two years after a cruise at sea. This plan went into operation, but it was soon abandoned, owing to the constant demand for midshipmen at sea during the Mexican war, and it was not until 1851, that the present uninterrupted course of four years at the academy was inaugurated.

Candidates are appointed upon the recommendations of members and delegates in Congress, to the Secretary of the Navy, on precisely the same terms as candidates for the Military Academy, and the President appoints ten, at large, as in the course of the candidates for West Point. They are admitted between the 20th of September and the 1st of October of each year, and if successful in the preliminary examination, are permitted to assume the naval uniform, and in the capacity of acting midshipmen begin their career on the school-ship "Dale," a third rate, sailing vessel of 675 tons, now stationed at Annapolis. The requirements for admission are now the same as at West Point, and the ages for admission from 16 to 18 years. In the autumn of 1872 the whole number was 260, and this included a class of 34 naval engineers. During the summer vacation two of the classes are drafted on board the practice-ship, to make a cruise at sea, to aid them in acquiring the duties of an officer and a sailor, and becoming familiar with the rigging and evolutions of a ship. They are subjected to eight severe examinations, and if successful in all, they receive a midshipman's warrant, and after two years of sea service they return for a final examination, which, if successful, gives them the warrant of passed midshipman; and further promotion depends for its speediness upon good conduct, the existence of war, naval expenditures, &c. The Superintendent of the Naval Academy is selected from officers not below the rank of commodore, and is assisted by an executive officer and twenty professors, and assistant professors. There is a valuable library of 20,000 volumes, and scientific apparatus, belonging to the academy.

Connected with the Naval Academy, a special course of instruction for a class of assistant engineers, was organized in 1865, under an act of Congress (July 4, 1864), and suspended in 1868, to be again instituted under regulations of the Secretary of the Navy issued in 1871.

(3.) *State, Incorporated and Private Schools.*

In 1820, Captain Alden Partridge, who was one of the earliest graduates of the National Military Academy, and associated with its instruction and administration, as assistant professor, professor, and superintent, from 1808 to 1815, began to agitate the subject of a union of military and scientific studies with the ordinary literary curriculum of the American College, and in September of that year opened at Norwich the American Literary, Scientific, and Military Academy, which received in the course of the four years following, 480 pupils, representing twenty-one out of the twenty-four States. In 1824 the institution was re-

* Barnard's Military Schools, p. 895.

moved to Middletown, Conn., and after 1828, twelve hundred pupils were instructed, for periods averaging two years, in such courses as they had the privilege of electing —but all were trained in the theoretical part of military science, and in the practical duties of the soldier, and in graduation were qualified to discharge the duties of a company officer, and, if necessary, to command a battalion in any corps of the army. Every year a military march was performed, in some cases extending to several hundred miles, and frequent scientific surveys, and reconnaissances, were made under the direction of the professor of civil engineering. The various military schools which subsequently sprung up in different parts of the country originated for the most part with Captain Partridge's pupils. He was himself connected with the Military Institute at Portsmouth, Va., in 1839, and with the Military College at Brandywine Springs, near Wilmington, in the State of Delaware, in 1853, and with the revival of the Seminary at Norwich, Vt., after the incorporation of the Wesleyan University at Middletown, in which the Literary, Scientific, and Military Institute was merged.

The most successful of the State Military Institutes is that at Lexington, Va., which was organized by Colonel Francis H. Smith, a graduate of the Military Academy at West Point, in the class of 1813, and professor there from 1834 to 1836. The State makes an annual appropriation of $15,000 for its support, on the basis of which 36 cadets are admitted without charge, in consideration of which they are required to teach in some school of the State for two years after graduation. Any commissioned officer of the militia of the State of Virginia, can become a student for a period not exceeding ten months, and receive instruction in any or all of the departments of Military science taught there, without charge for tuition. In the war of the Rebellion one tenth of the Confederate armies was commanded by the students of this school, embracing three major-generals, thirty brigadier-generals, sixty colonels, fifty lieutenant-colonels, thirty majors, one hundred and twenty-five captains, and over two hundred lieutenants. To the same armies, the Military Institute at Frankfort, Ky., the Cadet corps connected with the State arsenals in Norfolk, Richmond, Charleston, and other Southern cities, and the State Military Institutes in Alabama and Louisiana, furnished a large number of subordinate officers, which facilitated the early and better organization of the confederate forces.

(4.) *Military Tactics in State Scientific Schools.*

In the act of Congress (July, 1862), making grants of public lands to the several States for the endowment of State Schools of Agriculture, and the mechanic arts, it is provided that military tactics shall be included in the system of instruction*; and by an act of March, 1869, the President is authorized to detail an army officer to each institution, to instruct in such tactics. With these two provisions, and more efficient legislation, State and National, a system of military instruction associated with scientific studies generally, will be developed, which will at once develop the physical powers of the pupil, and train up a large body of well-educated men, ready to meet the exigencies of the public service as against foreign invasion, or domestic insurrection.

II. THEOLOGICAL SCHOOLS OR SEMINARIES.

Before the Revolutionary war, and indeed for some years after, no distinct school or institute for theological training was known in this continent. In New England, New York, New Jersey, and Pennsylvania the most eminent clergymen of the Congregationalist, Presbyterian, and Reformed (Dutch) churches, and later of the Baptist and Methodist churches, were in the habit of receiving into their families several students, usually graduates of the colleges, who served an apprenticeship under their direction in exegesis, the composition and delivery of sermons, and in the observation and practice of pastoral duties. Sometimes, if the clergyman was very eminent either as a preacher or a theologian, he would have a considerable number of students in his family at the same time, and his instructions assumed a more formal and systematic character. The most noted of these gatherings, suggestive of the subsequent organization of theological schools, were Rev. Dr. Bellamy's classes at his home in Bethlem, Conn., and a little later those of Dr. Hopkins in Hadley, and Dr. Emmons in Franklin, Mass.; the "Log College" of Rev.

* For an account of the system adopted in the Cornell University at Ithaca, N. Y., the State Agricultural College at Amherst, Mass. the State University in Louisiana, see Bernard's "*Military Schools.*" In the same volume will be found notices of various private military schools, by E. L. Molineux.

William Tennent at Neshaminy, Bucks Co., Pa., opened about 1728; a preparatory school opened by Rev. John Smith, and afterward conducted by Rev. Dr. Anderson, in Western Pennsylvania, about 1778; the instruction given to Baptist theological students in the early years of the present century by Rev. Dr. Staughton at Philadelphia, and by Rev. J. Chaplin, D.D., at Danvers, Mass. The colleges, too, it must be remembered, provided for more theology than they now do. William and Mary College, Virginia, had a Professorship of Divinity as early as 1693; Harvard, the Hollis Professorship of Divinity in 1721; and Yale, the Livingston Professorship in 1746. The college of New Jersey had a Theological Professor in 1769, Dartmouth College in 1782, and Brown University in 1791.

The first independently organized Theological Seminary was that of the Reformed (Dutch) Church at New Brunswick, founded in 1784 or 1785; the next was the Seminary of St. Sulpice (Roman Catholic) at Baltimore, Md., founded in 1791; a year later the Associated (Presbyterian) Church founded one at Canonsburg, Pa., now we believe extinct. In 1794 another branch of the same church (now United Presbyterians) established one at Xenia, Ohio. These were all the theological seminaries in the United States before 1800. In that year the very large Roman Catholic Seminary connected with Mt. St. Marys College, Emmittsburgh, Md., was organized. Andover Theological Seminary, the largest and oldest of the Congregationalists, was established at Andover, Mass, in 1807, and the Moravian Seminary at Bethlehem, Pa., the same year. The Cambridge Divinity School, Cambridge, Mass., (Unitarian,) was founded in 1811. The Princeton Theological Seminary (Presbyterian) dates from 1812; the Hamilton Theological Institute, Hamilton, N. Y., (Baptist,) in 1820; the General Theological Seminary (Episcopal) at New York City, in 1817; Hartwick Seminary (Lutheran) at Hartwick, N. Y., in 1816; Mercersburg, now Lancaster, Pa., Seminary (German Reformed) in 1825; the General Biblical Institute (Methodist Episcopal) at Concord, N. H., in 1847; the Seminary at Lewiston, Me., (Free Will Baptist) in 1830; the Bible Department of Eureka College (Christian or Disciples), Eureka, Ill., in 1852; and the Canton Theological School at Canton, N. Y., (Universalist) in 1858. There are now (about) 120 Theological Seminaries in the United States, with 400 Professors and (about) 3,400 students.

### III. LAW SCHOOLS.

The legal profession during the colonial period were, with few exceptions, very poorly qualified for the practice of the law. A few young men of the wealthier classes visited the mother country and entered at the Inner or Middle Temple in London, and having been admitted to the bar there, returned to the colonies and practiced their profession, and most of these received students in their offices, who gained some practical knowledge of law in the course of a long apprenticeship, but very few were familiar with the great principles which underlie all law, or their practical application to the cases which came up in their practice. Most of the eminent lawyers of the Revolutionary period (and some of them were men of great ability) were educated abroad. In 1784 the first law school in the United States was established at Litchfield, Conn., by Judge Reeve, who associated Judge Gould with him in 1798, and the two maintained the school together till 1823, when Judge Reeve died. In 1827 Judge Gould retired, and the school was given up. Messrs. Reeve and Gould were both men of great learning and tact, and by their instructions seven hundred and fifty lawyers were trained in the legal profession, many of whom have reflected the greatest honor upon it. There had been a Professorship of Law in William and Mary Colleges established about 1730; Brown University had one in 1790, but there was no law school connected with any college or university till 1817, when the Dane Law School of Harvard University was established. The Yale Law School was founded in 1820, and reörganized in 1843. In 1825 a law school was organized as a department of the University of Virginia, and in 1826 one at Washington, as a department of the Columbian College. There are now in the United States 40 law schools, with 140 professors and nearly 2,000 students.

### IV. MEDICAL SCHOOLS.

During the colonial period a few physicians were educated abroad, in the medical schools of Edinburgh, London, and Paris, and some who had already obtained a medical education emigrated to the colonies to practice. Among the latter was John Winthrop, the first physician of the New Haven Colony, and more than one of the early celebrities of New York, Philadelphia and Boston. Among the former were Dr. Shippen and Benjamin Rush of Philadelphia, Drs. Bard and W. P. Smith of New York, Drs. John Brockett and the Elder Munson of New Haven, and other of the New England Colonies. But the greater part of the physicians of that period received their only training in the offices and practice of the more eminent members of the profession, and were licensed either by the legislature or where these existed by county or colonial societies of physicians. The tendency of this practice of licensing was evident in the gradual lowering of the tone and culture of the profession, and its more eminent members lamented it. In 1762, Dr. Shippen of Philadelphia commenced lecturing on Anatomy to a class of young men who were studying medicine, and in 1765 he succeeded in making a sufficient degree of interest among the physicians of the city to organize the Medical Department of the University of Pennsylvania. Attempts were made soon after to organize a medical school in New York, but no permanent establishment was effected there till some years later. In 1782 or 1783, the Medical Department of Harvard University was established in Boston. In 1796, the Hanover Medical School, a department of Dartmouth College, was founded. Two or three short lived schools were set up in New York City, but none which had much reputation till the incorporation of the College of Physicians and Surgeons in 1807. There are now 57 medical schools or colleges of the regular practice in the United States, with about 100 professors and 6,000 students. About 1835 the pupils of Hahnemann began to introduce the Homœopathic practice into this country, and there are now six schools of this practice, with 80 professors and about 500 students. There are also four Eclectic and two Botanic Medical schools, with 40 professors and nearly 500 students. Of the regular medical schools four are exclusively for women, and two others admit both sexes. Of the Homœopathic schools, one is for women and one admits both sexes. Under the general head of schools of medicine must be named, also, the Dental Schools or Colleges, of which there are nine, with 70 teachers and about 300 students; and the Schools or Colleges of Pharmacy, of which there are sixteen, with 50 professors and about 600 students. The tables appended give full particulars of all these schools.

### V. NORMAL SCHOOLS AND TEACHERS' INSTITUTES.

Although teaching is not admitted with us to the rank of a learned profession, there has long been a conviction in the minds of the most eminent teachers and scholars that a process of careful training and instruction in the art of teaching was necessary, or at least desirable, for those who proposed to follow it as a calling. Three centuries ago Richard Mulcaster, upper-master of St. Paul's school, and afterwards head-master of Merchant Taylors' school, in his "Positions" published a plea for a college for the training of teachers, including a plan which in latter times has been but little amended. The teachers of the colonial period, as we have already shown, were not trained to their work in any institution designed specially for the instruction of teachers, and for the want of this training, while many became eminent by natural aptitude, the majority were less successful than with their remarkable natural qualities they should have been.

The first suggestion in this country looking toward the establishment of schools analogous to our Normal School,* was made in the *Massachusetts Magazine* for June, 1789, in an article by Elisha Ticknor, advocating the establishment of county schools "to fit young gentlemen for college and school keeping." It was just fifty years after (1839) that this suggestion bore fruit in a resolution which authorized the establishment of Normal Schools in Massachusetts. In 1816, Denison Olmsted, subsequently Professor of Mathematics in Yale College, in his Master's Oration proposed the establishment by the State of Connecticut of an academy to train *schoolmasters* for the State common schools. In 1823, the Rev. Samuel Read Hall opened a select school at Concord, Vt, in which he advertised to give a course of instruction adapted to teachers. In 1825, two series of articles were published almost simultaneously, one in Hartford, Conn., by Rev. Thomas H.

* See History of Normal Schools in Barnard's *American Journal of Education*, Vol. 13, p. 756.

Gallaudet, and the other in Boston by James G. Carter, Esq., proposing, each without any knowledge of the other's views, among other things the establishment of a seminary or institution for the education of teachers. These two series of papers were soon after published in pamphlet form. In 1827, Mr. Carter,* with some assistance from the town of Lancaster, Mass., established there a private seminary for the instruction of teachers. From 1830 to 1842 a seminary for the instruction and training of teachers was maintained in connection with Phillips Academy, Andover, under the charge of Rev. Samuel Read Hall.* In the same year, (1826,) W. R. Johnson,* then residing in Germantown, Penn., without any knowledge of the views of Messrs. Gallaudet and Carter, published a pamphlet entitled "*Observations on the Improvement of Seminaries of Learning*," in which he set forth the necessity and advantages of schools for the special training of teachers. The same year Governor DeWitt Clinton, in his annual message to the Legislature of New York, commended to their consideration the education of competent teachers, and in 1826 recommended the establishment of a seminary for this purpose, in which the methods of Lancaster should be adopted. For several years following, this matter occupied the attention of the committees of education in the New York Legislature, and efforts were made in 1835 to provide normal instruction through the academies of the State by appropriations for that purpose from the literature fund, but these failing in producing the desired result, the State Normal School in Albany was established in 1844, and in 1867 provision was made for four more in different parts of the State. But Massachusetts preceded New York in the establishment of Normal Schools by five years.

After twelve years of agitation in Massachusetts by James G. Carter, George B. Emerson, Charles Brooks,† the Secretary of the Board of Education, Hon. Horace Mann, and the noble gift ($10,000) of Hon. Edmund Dwight, seconded by other devoted friends of education, three Normal Schools, at Lexington (afterward removed to West Newton, and later to Framingham), Westfield, and Bridgewater, the first exclusively for women, the other two for both sexes, were established in 1839. In 1854, another, also for women only, was established at Salem. There are now in the United States between eighty and ninety institutions designated Normal Schools, aside from city training schools, and normal departments in colleges and seminaries which profess to give instruction in the art of teaching. In these schools and departments there are about 475 teachers, and nearly 12,000 pupil-teachers. The location, special character, and attendance of the more prominent of these institutions will be found in the table appended.

The course of study in these schools extends over two or three years for those who wish to graduate, though those who are qualified to do so can enter the advanced classes. Generally there is no instruction in either ancient or modern languages, except English; but in some of the Western Normal Schools, Latin, Greek, and German are optional studies. Aside from the languages (which are pursued by a very small number) the course comprises the studies of our best High Schools, with extra drilling on the elementary branches and the art of teaching. The instruction in all the branches is twofold in its character; aiming to impart a thorough knowledge of the subjects taught to the teacher pupils, and displaying also the best methods of communicating this knowledge to children. As theory and practice should go together, experimental and model schools are usually connected with the Normal Seminary in which the students learn by observation and actual practice how to organize, manage, and teach ordinary graded schools.

Normal Schools have accomplished a great amount of good in raising the standard of qualifications required of the teachers of our public schools, and the range of studies taught in them, and there is a fair ground of hope for their still greater usefulness in the future; but to this end certain improvements in their management are necessary, which we may briefly indicate here: 1st, There should be a materially higher and uniform standard of attainment required for admission to them. At present very little more than the most elementary knowledge of reading, writing, arithmetic, and primary geography, grammar, and history are demanded. With this advanced standard of admission, the two or

* Barnard's Normal Schools and other Institutions for the Professional Training of Teachers.

† For special notice of the labors of Rev. Charles Brooks, see Barnard's *American Journal of Education*, Vol. I., p. 587; XVI., p. 89; XVII., p. 721.

three years course would be of much greater service. 2d, The pupils should be induced, if possible, to remain through the entire course, as whatever may be their previous scholarship, they can not in a shorter time acquire the best methods of teaching what they may know very well. 3d, The German language, and perhaps also a moderate knowledge of Latin and French should form a part of the complete course. There should also be a more extensive or post graduate course, to qualify teachers for the higher positions, such as principals of higher schools or academies, professors in colleges, similar in character to the philological and pedagogical seminaries on the continent of Europe, and at least one for the training of teachers and professors of scientific schools. It is perhaps too early for the organization of training schools for the technical arts and trades, such as for first-class printers, booksellers, &c., like those of Leipsic and the other German cities. 4th, The faculty of instruction is in most of these institutions too small for the number of pupils, and for efficient instruction. 5th, There is a great necessity for endowments or of scholarships to reduce the expense of the prolonged residence of poor but promising pupils. 6th, There should be a better defined gradation of the pupils and a minimum standard of attainment prescribed in each grade, failing to attain which the pupil should not receive the diploma of his grade, whether as a teacher of primary, intermediate, grammar, or high schools. 7th, The examinations should be by papers, and very thorough and searching, accompanied by trial-lessons in the model school, or any ordinary public school.

*Teachers' Institutes and Associations.*

Another less perfect but highly beneficial method of improving teachers in their work is the Teachers' Institute. A Teachers' Institute is a voluntary assembling of the teachers of a county, assembly, congressional or judicial districts at some central point, for instruction for one, two, three, or even six weeks, by competent instructors or lecturers in the best methods of teaching the studies pursued in our public schools. The exercises are also varied by singing, readings, and recitations, discussions on school topics, and the reading of essays on the various methods of imparting instruction, in which parents and citizens take part.

The first assembly of teachers of this kind was held at Hartford, Conn., in 1839, solely at the expense and on the suggestion of the then Secretary of the Board of Commissioners of Common Schools in Connecticut.* It was remarkably successful, and was repeated in the spring of 1840. The beneficial results of these gatherings were so evident that they were soon adopted and provided for by the Legislatures of most of the Northern and Western States. In Pennsylvania they were held in each county, and gatherings for a longer term (from six to twelve weeks) under the title of Normal Institutes, were held in each judicial district. These assemblages, though not fully a substitute for Normal Schools, yet in some respects exert even a more beneficial influence. They enlist the interest and sympathies of parents and citizens, as well as of the children; bring the teachers of a county or district into more intimate acquaintance with each other, rouse a healthy spirit of emulation, and develop an *esprit de corps* among the teachers which will lead to better views of their profession and greater zeal in it. Probably not less than 50,000 teachers annually enjoy the benefits of this inexpensive course of instruction.

Another class of organizations for the advancement of the teachers' profession is found in the State and other Teachers' Associations. One of these have been in existence over forty years, but the greater part have come into being within thirty years. They occupy their sessions largely with the discussion of methods and systems of teaching, text-books, apparatus, periodicals, &c., but find some leisure for the promotion of the financial, social, and moral advancement of the profession. Most of these associations own or control an educational periodical, in which teachers discuss methods of instruction with great freedom, and with constantly increasing ability.

## VI. SCHOOLS OF APPLIED SCIENCES.

### 1. *Agricultural Schools and Colleges.*

There have not been wanting for the last two thousand years writers who have made it their business to impart instruction to their readers in regard to the culture of their fields, the rearing of cattle, the succession of crops, and the care of the vine.

* See Barnard's *American Journal of Education*, Vol. 17, p. 804.

The writings of Cato, Virgil's Georgics, the Essays of Pliny, Varro and Columella, and later Virgil Polydore, Sir Anthony Fitzherbert, Thomas Tusser, Barnaby George, Walter Blithe, Richard Westen, Jethro Tull, Arthur Young, and Albrecht von Thaer, are full of instruction in regard to agriculture, both as a science and an art. The first suggestion of a school or college for instruction in agriculture, so far as can now be ascertained, was made by Samuel Hartlib, in an essay published in 1651. This was seconded by Abraham Cowley in 1661, in a treatise on the foundation of a Philosophical College, and an essay on agriculture. These suggestions bore no fruit for nearly one hundred and fifty years. An attempt was made to establish an agricultural school in the park of Chambord in France, by the Abbé Rosier, in 1775, but owing to the impending revolution in France it was unsuccessful. De Fellenberg's Agricultural School at Hofwyl, Switzerland, projected in 1799, but not fully organized till 1806 or 1807, was really a Normal School, with its course of lectures on agriculture forming one of its branches of instruction, and its practice of agricultural labor by the pupils of the school. An agricultural school of higher order and more directly devoted to instruction in both the science and the art, was that founded in 1799 by Prince Schwartzenberg at Krumau, in Bohemia, and which is still in existence. Albrecht von Thaer founded an agricultural school at Celle, in Hanover, in 1799, which was subsequently transferred to Möglin, and with greatly enlarged facilities became in 1810 the Royal School of Agriculture in Prussia, and is still continued. He was Professor of Agriculture in the University of Berlin from 1810 to 1828. Its course of instruction is very thorough, and its illustrative collections ample. There are now more than four hundred agricultural schools in Europe, about thirty of them of the highest grade, among which the most celebrated are those of Hohenheim in Wurtemberg, Schleissheim in Bavaria, Poppelsdorf, Glasnevin in, Ireland, Plagwitz in Saxony, and Cirencester, England.*

In the United States, though there had been much discussion and the desirableness of agricultural schools was generally admitted, there was no successful effort for their establishment till about 1854, though the "Cream Hill Agricultural School at West Cornwall, Conn, a private boarding school for boys, in which agricultural studies were mingled with those of the usual course of the secondary schools, had been in existence since 1845; and there had been an annual course of about 30 lectures on agriculture given in Yale College since 1847. The Michigan State Agricultural College at Lansing was projected in 1850, but was not opened till 1857. The Farmers' High School of Pennsylvania, now the Pennsylvania Agricultural College, near Bellefonte, Center Co., Pa., was projected in 1854, opened in 1856, and reörganized in 1859. The Farmers' College, at College Hill, near Cincinnati, and the Agricultural College at Cleveland, Ohio, both commenced their course of instruction about 1856, as did also the Westchester Farm School, a private institution, under the charge of Messrs. Henry S. Olcott and Henry C. Vail. The New York State Agricultural College at Ovid, after a struggle of four or five years, broke down completely, and finally was succeeded by Cornell University, which has a flourishing agricultural department. Maryland founded a State Agricultural College at Hyattsville in 1857. Iowa established a "State Agricultural College and Model Farm" in 1858, but it was in an embryonic state for several years. These were, we believe, all the agricultural colleges or schools giving direct instruction in the science of agriculture previous to 1863.

On the 2d of July, 1862, the President of the United States signed an act of Congress known as the Agricultural College Land Grant, which provided that there should be granted to each State thirty thousand acres of the unsold and unreserved lands of the United States for each Senator and Representative such State was entitled to in Congress, said lands to be sold by each State or its assigns, and the proceeds of such sale to constitute a fund which should be safely invested, the interest to be used to aid in the maintenance "of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical

* A full description of the schools designated will be found in Barnard's *Scientific and Industrial Education*. NEW YORK. STEIGER, 1872.

education of the industrial classes in the several pursuits and professions in life." *

The passage of this act gave a powerful impulse to the organization of Agricultural Schools or Colleges. In 1871 thirty-four States had accepted the national grant, and thirty of these had taken measures either for the endowment of an agricultural department in some existing institution or for the establishment of a new College of Agriculture and the Industrial Arts. In New England, four of the States, Vermont, New Hampshire, Connecticut, and Rhode Island bestowed their share of the national grant on already existing historic institutions in their respective bounds,—the University of Vermont, Dartmouth College, Yale College, and Brown University, in each of which departments of agriculture and the mechanic arts have been established. Maine founded a "State College of Agriculture and the Mechanic Arts" at Orono; and Massachusetts, dividing her grant, gave one-third to the Institute of Technology at Boston, and two-thirds to a new Agricultural College founded at Amherst, but having no direct connection with the existing college there. In New York, after some experiments in other directions, the magnificent grant of 990,000 acres of land was bestowed as an endowment upon the new but already flourishing Cornell University, whose curriculum embraces the widest possible diversity of studies. In Ohio, Indiana, Illinois, Kansas, Minnesota, Oregon, and West Virginia new institutions have been founded, though that of Minnesota was subsequently made a part of the State University already in existence. In Indiana, the Purdue College, and in Illinois, the Illinois Industrial University are liberally endowed, and give promise of becoming efficient institutions. Pennsylvania, Michigan, Maryland, and Iowa, have bestowed their grants upon Agricultural Colleges already existing in their respective States, greatly to their advantage and usefulness. New Jersey, Delaware, Virginia, North Carolina, Georgia, Mississippi, Louisiana, Tennessee, Kentucky, Missouri, Wisconsin, and California have intrusted theirs to literary institutions already existing to form in them departments of Agriculture and the Mechanic Arts. In all, then, there are thirty of these agricultural colleges, schools, or departments already in operation, which have received the national grants, and several others, in which agricultural science forms an important though somewhat subordinate section of a scientific course.

The course of study in agriculture varies in these institutions from a variety of causes. In some, it is wholly theoretical; in others, theory and practice of agriculture are mingled in diverse proportions. In some the highest scientific principles, the analysis of soils and products, the adaptability of natural and artificial manures to particular soils, the geology, mineralogy and botany of particular sections, the mathematics of agriculture, the requirements of temperature, the influence of locality upon crops, the laws of forest growth, and the sciences of draining and irrigation, occupy the time of the student; others, with an eye to more immediate results, devote their time and instruction more fully to practical details, such as the rearing of cattle, sheep, and swine; the diseases to which each are subject; the best methods of fattening and marketing them; the culture of the vine, and of small fruits; of the different grains; market gardening; the cultivation of fruit, or the methods of silk, hop, or tea culture. Each of these systems has its advantages, and the accomplished agriculturalist should attain a knowledge of all. Agricultural schools, it will be seen from this brief review, are yet in their infancy in this country, and there is yet great room for progress in their management and instruction.

2. *Commercial Schools or Business Colleges.*

These are entirely of modern creation, the oldest of them having been organized in 1850. Considerably more than one-half of them, and among the number those most widely advertised and most largely attended, are private enterprises, adventure schools as they would be termed in Great Britain, started purely as business speculations. The time required for their course of instruction varies from thirty days to two years. They give instruction in penmanship, book-keeping in all its branches, business forms and technicalities, and some of them in banking and finance, exchange, insurance, postal regulations and service, custom-house brokerage, and telegraphy. In a very few, instruction is given in French and German to an extent sufficient for busi-

* The credit of originating and conducting this act through Congress belongs to Hon. J. S. Morrill, on its first introduction a member of the House, and subsequently of the Senate, from Vermont. In 1873 he secured an additional act by which a portion of the land sales hereafter is assigned annually to the State Agricultural Colleges.

ness correspondence. Most of these studies should come into the regular course of our Grammar or Secondary Schools, and these should be supplemented by evening schools for those who are unable to attend in the daytime. In the absence of this legitimate school instruction they have undoubtedly proved of advantage to many of those who sought a business training. There are in all about ninety of these commercial schools. The number of teachers in them is nearly or quite 200, and of students about 8,000.

3. *Scientific Schools Proper.**

Under this head we include Schools of Technology or Science, in its applications to the useful arts and business; Schools of pure Science, as higher mathematics, natural history, physical science; Schools of Engineering, civil or military; Schools of Mines and Mining Engineering; Schools of Philology and Linguistics; Schools of Architecture, and Schools of the Fine Arts (drawing, painting, sculpture, and music.)

The first of these scientific schools in the order of time, and one of the first in the order of merit, is the Rensselaer Polytechnic Institute at Troy. This institute grew out of the efforts of the "patroon," late Stephen Van Rensselaer, to promote the diffusion of practical science among the farmers and mechanics of the State of New York. In 1820 and 1821 he had caused a geological and agricultural survey of the counties of Albany and Rensselaer to be made at his own expense, and had also procured the services of the late Prof. Aner Eaton, and the late Professor and President of Amherst College, Dr. Edward Hitchcock, to survey a transverse section from Boston to Lake Erie, noting its geological structure, the varieties of soil and analyzing the soils and crops of this section. In 1823 and 1824 he employed Prof. Eaton and a number of competent assistants to traverse the State on the line of the Erie Canal and deliver popular lectures on philosophy, chemistry, &c., with experiments. In the autumn of 1824 he founded the Rensselaer Institute at Troy, for the purpose at first of giving instruction in Natural History, Geology, and Chemistry, as well as in the higher Mathematics and Physics. For fifteen years he sustained this school in great part from his own ample means, giving free tuition to one student from each county, on the recommendation of the County Clerk, but requiring that these students should teach for one year in their own counties. After Gen. Van Rensselaer's death, Civil Engineering was made a prominent feature in the course of study, and with the pecuniary aid of the Van Rensselaer family, it continues its high position as a school of science and engineering.

In many instances the schools organized under the national grants of lands, or receiving aid from these grants, include one or more of these classes of schools with their instruction in agriculture. Instruction in mechanics, by the terms of the act, is included in all or nearly all of them; and where the endowment has been bestowed upon a scientific school already in operation, physical science, engineering, mining, &c., have also been included. There are a considerable number of schools which do not participate in these national grants, but are more or less liberally endowed from other sources. Among those most largely endowed we may name Lehigh University at South Bethlehem, Penn., which has received from Hon. Asa Packer, in all about one million dollars; the Stevens Institute of Technology at Hoboken, N. J., whose endowment, aside from land and buildings, is $500,000; the Scientific Department of Lafayette College, Easton, Pa., amply endowed by Mr. Pardee; the Massachusetts Institute of Technology, largely endowed by Dr. Walker and others; the Worcester Free Institute, endowed by Messrs. Boynton and Washburne; the Lawrence Scientific School of Harvard University, and the Street School of Fine Arts of Yale College; the Chandler Scientific School and the Thayer Engineering School of Dartmouth College, are among the most conspicuous. One of the most remarkable in its practical efficiency for the free education of the working classes in mathematical and technical science is the Cooper Union of New York. This magnificent foundation, the gift of a man of the people, whose days were spent in hard and severe labor from youth to old age, provides for the free instruction of large classes in all departments of practical mathematics, in the various branches of mechanics, in chemical technology, the principles of natural philosophy and physics, in drawing and designing, in engraving, in painting and architecture. More than two

* For details, see Barnard's *Scientific Schools*, Vol. II.

thousand students, of both sexes, are constantly attending its classes and lectures, and great numbers are necessarily turned away for want of room for their instruction. The Rensselaer Institute at Troy, N. Y., the Polytechnic College of Philadelphia, Cornell University, the Purdue College in Lafayette, Indiana, the Illinois Industrial University at Urbana, Ill., and the Scientific Department of Washington College, St. Louis, as well as some of the younger of the national endowed colleges, are giving courses of scientific and technical instruction which will prove of great service. As yet, however, very few of our scientific schools are prepared to give the best practical teaching. Ten or twenty years hence, with still more liberal or more available endowments, with museums and cabinets replete with the material for illustrative instructions, and above all with thoroughly competent instructors in the highest departments of scientific research, men who have dedicated their lives to science without the apprehension of an old age of poverty, we may expect results unsurpassed in the best scientific schools of Europe.

Civil Engineering is taught in quite a number of our scientific schools, and is becoming a very important department of higher education; Military Engineering is taught, of course, in the Military Academy at West Point, and Civil Engineering also with great thoroughness, many of our best civil engineers having been graduates of this academy, and of the State military institutes of the south and west. Mining Engineering and Metallurgy are taught in the Columbia College School of Mines, the Polytechnic College of Philadelphia, Lehigh University, South Bethlehem, Pa., and, we believe, in one of the St. Louis scientific schools. Philology is only made a distinct branch of instruction at Yale College, New Haven; at Cambridge, and at Lafayette University, Easton, Pa. Architecture is not generally taught in the scientific schools, the Massachusetts Institute of Technology being, perhaps, the only exception, though a department of it, Landscape Gardening, is beginning to receive attention in some of them; but the Institute of American Architects in New York, and other similar bodies elsewhere, have established schools for instruction in this branch. Drawing, Painting and Sculpture are taught in the School of Fine Arts at New Haven, in the schools of the American Academy of Design, and the Cooper Union at New York, the Brooklyn Academy of Design, and in kindred institutions in Boston, Philadelphia, Baltimore, Cincinnati, St. Louis and Chicago. Music in its higher developments is taught in the Peabody Institute at Baltimore, and in the Conservatories of Music found in most of our large cities, which depend mainly on the reputation of some eminent private teachers.

Some departments of Natural History are taught successfully at Cambridge in connection with the magnificent Museum of Comparative Zoölogy, collected by the indefatigable labors of Prof. Agassiz, but for the most part the prosecution of these studies is most profitably conducted in connection with the institutes and academies of natural science, of which we may mention the Boston Natural History Society, the Essex Institute of Natural History at Salem, the State Natural History Rooms at Albany, the Metropolitan Museum so auspiciously begun in New York, the Lyceum of Natural History in the same city, the American Academy of Natural Sciences in Philadelphia, and for this and technology the Franklin Institute in the same city, the Smithsonian collections at Washington, and lesser but considerable collections at Williams College and Amherst College, Mass., Cornell and Rochester Universities, New York, in Cincinnati, Chicago, St. Louis, and elsewhere.

### VII. ORPHAN ASYLUMS AND SCHOOLS.

In all the ages since the Christian Era there has been manifested a tenderness toward the orphan, and foundations for the care and education of children bereft of one, or both parents have been established throughout Christendom in great numbers. The Roman Catholic Church, both in Europe and the United States has been particularly regardful of these children, and has established its asylums wherever there was a sufficient number of orphans who could be gathered into them. The Moravians, Lutherans, and Reformed Churches on the Continent, and Churchmen and Dissenters in England vied with each other in promoting the same good work. One of the largest Orphan Houses in Europe to-day is that of George Müller, one of the Plymouth Brethren, at Ashley Downs near Bristol. It is of great extent, supported wholly by voluntary charity, no contributions being ever directly solicited, and furnishes care, food, lodging, clothing, and education annually to nearly 3,000 orphans.

In the United States, Orphan Asylums were established by the Moravians in Pennsylvania and Georgia early in the eighteenth century. In 1740, the celebrated preacher George Whitfield laid the foundation of his Orphan House at Bethesda, ten miles from Savannah, Ga. Several other Orphan Asylums were established in New England, Pennsylvania, and Maryland before 1800, but the whole number in existence in the United States at that time did not exceed six or seven. It was the practice to a very great extent, among the wealthy families, to adopt and bring up orphan children, and this practice obviated in ordinary times and with the sparse population, the necessity of asylums. The first Orphan Asylum in New York City was organized in 1806. It was at first attempted to place the children in families, as is still done in some of the institutions for orphans in the German States, but the number of orphans rendered this difficult, and they rented and subsequently erected an asylum in Bank street, whence they removed in 1840 to their present spacious edifice on the banks of the Hudson, between Seventy-third and Seventy-fourth streets. The Lake and Watts Orphan Asylum, endowed largely by the gentlemen whose names it bears, is a large and admirably managed institution. There are now thirteen orphan asylums in New York city, aside from the Randall's Island Nursery, where 1,700 or 1,800 children—orphans, half-orphans, or children of intemperate or criminal parents, are cared for; aside from 8,000 children, the Home for the Friendless, the Five Points House of Industry, Children's Aid Society, and other preventive institutions, a large proportion of whose inmates are orphans. There are two asylums for colored children, and one specifically for soldiers' orphans. In Brooklyn there are five asylums, all well sustained. In all of these institutions there are schools under the supervision of the city schools' authority, which receive their share of the public school money.

Philadelphia is renowned for her munificent foundations for the care and instruction of orphans. The Girard College, whose buildings and lands cost nearly two millions of dollars, and which has an endowment of almost a million and a half, received from its wealthy founder, has about five hundred orphans constantly under instruction. It was opened in January, 1848. Its course of instruction extends over seven years. The amount of annual expenditure is about $80,000. Several other orphan asylums and schools in Philadelphia are largely endowed; the Burd Orphan Asylum, founded in 1859, for orphans between four and eight years of age, has an endowment of about half a million. The Lincoln Home for Orphans in Philadelphia is believed to have been the first endowed institution for soldiers' orphans in the country. There are now thirty orphan asylums for these children specifically in the State. Boston has a number of orphan asylums and schools, generally admirably arranged. All our large cities have from two to six, and there are few towns of 10,000 inhabitants in the country which have not at least one, generally in connection with some religious organization. It has proved impossible hitherto to obtain any full or accurate statistics of them. Not less than 75,000 children receive both support and education in them, and though objections may be made to them on the ground of their formality and want of the family element, they relieve a vast amount of destitution, and impart elementary instruction to a large class of children who would otherwise perish, or grow up in ignorance to vice and crime.

### VII. SCHOOLS AND COLLEGES FOR INDIANS.

From the first settlement of the colonies which now constitute the United States, there has been on the part of benevolent christian men a desire to educate the Aborigines, or at least such of them as could be induced to devote their attention to study. Like all savages, the Indian is naturally intolerant of confinement and restraint, and soon wearies of unremitting application to either study or mechanical employment. There have been exceptions to this rule, but they are so few as to prove its general truth. But the efforts of good men were unceasing to teach them the elements of learning and the rudiments of those arts which accompany civilization. While the Indian continued a nomad it was impossible to make any permanent impression on him. Civilization requires as its basis a fixed home. Hence, though Eliot and the Mayhews, the Jesuit Fathers in Canada, at Detriot, Kaskaskia, St. Louis, Natchez, and other points, and later Count

Zinzendorf and the Moravians, took great pains to acquire the Indian languages, and to teach them the rudiments of science and religion, they were only successful when they could gather the wandering tribes into permanent settlements,—missions, the Jesuit Fathers called them,—and then erecting the requisite churches and school-houses, accustom them to a fixed home. In New Mexico, in Texas, in California and Oregon, the Jesuit Missionaries planted many of these missions, some of which are still in existence. The education imparted, except in the arts of civilized life, was not extensive. A few were taught to read and write, most of them learned to repeat the prayers of the church, and occasionally one of their number more ambitious and intelligent than the rest, would receive sufficient education to become the curé of a pueblo, or Indian village. In the English colonies the earliest effort for the instruction of the Indians was made in Virginia in 1618. For this purpose an appeal was made to England by the Virginia Company, and the Queen (Elizabeth), and many of the nobility and clergy contributed to the fund. At Cambridge, Mass., a school for the instruction of Indian youth was founded before Harvard College, and was in some sense the germ of that first of American Colleges. In Connecticut, there were schools for Indian children and youth as early as 1648 to 1660, at several points, as at Farmington, Podunk, Hartford and Branford, and some of these schools were maintained for more than a hundred years. In 1725 there was a school for Mohegans at Norwich, and the education of Samson Occum, an Indian, and afterward a preacher, in the family of Rev. Eleazur Wheelock at Lebanon, Conn., in 1743–1750, led to the founding of Moor's Indian Charity School in 1754, which sixteen years later was practically merged in Dartmouth College.*

About the beginning of this century systematic efforts were commenced, mostly by the general government, for the instruction of the Indian tribes within what were then the boundaries of the States. The *Iroquois*, or Six Nations, who had established themselves on reservations in the State of New York, the fragments of the Orono, Pequot, and Mohegan tribes who remained in Maine and Connecticut, and the considerable tribes of Cherokees, Creeks and Choctaws, who inhabited the northern portions of Georgia, Alabama and Mississippi, and the Seminoles of Florida, all received missionaries and teachers, and made fair progress in learning and civilization. George Guest, a Cherokee, invented an alphabet, and reduced the language of his tribe to writing. But the rapid influx of white settlers into the Gulf States, and their jealousy of these peaceful Indian tribes led to peremptory demands for their expatriation to lands beyond the Mississippi. This removal seemed unjust at the time, and was carried out with unnecessary harshness and hardships, but in the end it proved of great advantage to the tribes which were removed, and they have formed the nucleus of an Indian territorial settlement in which the larger portion of the nomadic tribes of the western plains have found or will find a home and a permanent settlement. The Cherokees, Creeks, and Choctaws have attained to a very respectable civilization; they have numerous good schools, some of them of the secondary grade, and have entirely abandoned their nomadic habits. There are now schools, sustained in part by the government and in part by the different religious denominations, in all the tribes which occupy distinct reservations, even though these tribes have not fixed settlements. There were in 1871, as nearly as could be ascertained, 294 schools among the Indians, with about 300 teachers, and about 8,000 scholars, the total Indian population being estimated at 383,130.*

VIII. SCHOOLS FOR THE AFRICANS AND FREEDMEN.†

Very early in the history of the colonies which afterwards became slave states, there was evident a determination to withhold both from the slaves and the free people of color all facilities for education; and though for a time the instruction of house servants, who were often allied by blood to their masters, was tolerated and sometimes encouraged by influential people, yet as early as the beginning of this century, in most of the slave states, it was forbidden under penalty of fine and imprisonment to teach a slave to read or write. This prohibition was in some, perhaps in many cases, evaded; the children of a slaveholder often teaching

* See Barnard's *History of Education in Connecticut.*

* For a more particular account of the attempts to establish schools for the Indians, see Barnard's contributions to the *History of Education in the United States*. STEIGER, 1873.

† A special Report on Schools for Colored Children and the educational status of the colored population in the different States, will be found in Barnard's *Special Report on the District of Columbia* which constitutes Vol. XIX of the American Journal of Education.

a favorite slave what they themselves had been taught, but the law remained on the statute books, and was enforced whenever there was any excitement in regard to the slaves. As the free colored people were supposed to be most forward in teaching the slaves, the same prohibition was in many of the States extended to them, and in others the terms of a public opinion which regarded, or professed to regard, the free colored people as nuisances, was invoked to prevent their instruction also. This was generally effected, except in three or four States. In the District of Columbia there have been schools for free negroes in existence constantly from 1807 till the present time, and most of the time two, three, or more at the same time. The first was founded by the efforts of George Bell, aided by Nicholas Franklin and Moses Liverpool. These three men had been slaves but had attained their freedom, but neither of the three could read or write. Yet they built a school-house, and for some years sustained a school. In 1809, or thereabouts two others were started, one by a colored woman, Mrs. Anne Maria Hall, the other by an Englishman, Mr. Henry Potter. In 1818, the free colored people formed an association under the name of "Resolute Beneficial Society," and established a very good school which was sustained for several years. The best of these early schools was one taught by Rev. John F. Cook, a colored Presbyterian minister, self-educated, but a man of rare ability and talent, who conducted an excellent school—"The Union Seminary"—for about twenty years, from 1834 till 1855, and it was maintained by his sons, with some intermissions, till 1867. There were also two or three schools maintained under the direction of Father Vanlomen and other Catholic priests, taught by colored women of remarkable talent. The Wesleyans had also a seminary from 1833 to 1865. But the most noteworthy of these schools was that founded and conducted from 1851 to 1866 by Miss Myrtilla Miner, a lady of Brookfield, N. Y. This was a seminary of the higher class for colored girls. We have not space to go into the history of this school and her connection with it, but it is sufficient to say that she deserves as much honor, and perhaps even higher consideration than Mary Lyon, the founder of Holyoke Female Seminary. Her devotion to her work was as great, her sacrifices were greater, and she passed through a fiery trial of persecution, while her life was one of constant and intense suffering. At the time of the emancipation of the slaves there must have been in Washington and Georgetown some ten or fifteen of these colored schools. In Delaware, the Friends had had in Wilmington two good schools for colored children since 1840. In Maryland there was a Catholic seminary for colored girls, established in 1831, in connection with the Oblate Sisters of Providence Convent. The Wells school, endowed by a man of color, established in 1835, and some others. In Kentucky, the Berea College, founded in 1858 by Rev. John G. Fee, for the higher education of white and colored youth, was the only institution of its grade in the slave States for colored persons previous to the war.

In the Northern States there were schools for colored children exclusively in many of the large cities. One of these in New York was established in 1704. In 1788 or 1789, the Manumission Society established colored schools which were continued till 1834, when they were merged in those of the Public School Society. In Boston, a colored school was established in 1798, and a public school for colored children in 1800. In Cincinnati they were established as early as 1820. A school of higher grade established there in 1835 evoked a storm of persecution, but was maintained steadily until the public provision for the higher education of colored youth was sufficient to render its further continuance unnecessary.

In Philadelphia the efforts for the education of the colored race, of Anthony Benezet in 1750, and subsequently of the Friends in 1770, and of the Pennsylvania Abolition Society in 1794, aided and supplemented by other benevolent organizations at a later period, provided for the people of color in that city exceptional advantages of education. In the country the few colored children generally attended the same public schools with the white children, though they were in most cases jealously excluded from the private schools. In the deaf mute, blind and orphan asylums they were generally admitted on equal terms with white children. But up to 1850, and in some of the Northern States still later, there was so strong a prejudice against giving to the colored people any opportunities for higher education that no school for that purpose was tolerated. In 1833, Miss Prudence Crandall, a member of the Society of Friends and a teacher of high reputation, received a young colored girl into her boarding and day-school at Canterbury, Conn., that she might qualify herself to become a teacher to her own race. The girl was not in any way objectionable; she was of pleasing appearance and manners, and of most exemplary conduct, a member of the Congregationalist church in Canterbury. Objection was made by the parents of some of the white children attending this school, and Miss Crandall, firm in her principles, determined to make it a test question, and, therefore, gave notice of the opening of a school for colored girls. This was soon largely attended, but the people of that and adjacent towns were greatly excited in consequence, and an influential citizen, afterward a member of Congress, and Judge of the United State District Court, procured the passage of a law by the legislature in 1833 which prohibited such a school, under penalty of heavy fine or imprisonment. Under this law Miss Crandall was arrested, committed to the Windham County jail, and subsequently tried; the first time the jury disagreed; the second, on Judge Daggett's charge, she was convicted, but an appeal being taken to the Supreme Court of Errors the action was quashed. Her school was, however, broken up by the constant assaults made on the teacher, scholars, and the school building.

In 1850, Avery College, founded by Rev. Charles Avery, was opened at Alleghany City, Penn., as a collegiate and academical school for persons of color of both sexes. It has about 75 students, is well endowed, and has an efficient faculty. Lincoln University at Oxford, Chester County, Penn., originally called Ashmun Institute, was founded in 1854 by the Presbytery of Newcastle, Pa., for the scientific, classsical and theological education of young men of color. It was not opened till Dec. 31, 1856, and had in 1871, 158 students. It is moderately well endowed. Wilberforce University near Xenia, Ohio, founded in 1856 as a collegiate institution for young men of color by the Cincinnati Conference of the Methodist Episcopal Church, was by that conference transferred to the African Methodist Episcopal Church, and is now sustained by the people of color, one of their bishops, Rev. Dr. D. A. Payne, being President and Professor of Theology. It had in 1871, 176 students of both sexes, and 7 instructors. These three institutions, and Berea College, Ky., were all in existence previous to the war, and their students were wholly or mainly persons of color. Several other colleges, however, admitted colored students to their classes regularly, and still others occasionally. Oberlin has, since 1836, always had colored students.

The escape of many who had previously been slaves from their masters in the first year of the war, and the Proclamation of Emancipation in January, 1863, soon demonstrated the necessity of furnishing educational advantages to these new citizens. The Freedmen, as the emancipated slaves were now called, were clamorous for elementary education. They flocked to the schools which the various philanthropic and religious societies established for their instruction, in great numbers, and though among the adults, whose minds had been hitherto wholly untrained, progress was very slow, yet by dint of the most undaunted perseverance, great numbers learned to read, and the colored children, in most cases, proved apt scholars. Great hostility was manifested toward these schools in the late slave States by a class of the white population, who were for the most part themselves illiterate, and jealous of the improvement of the blacks; and many school-houses were burned, and some teachers as well as a considerable number of the pupils were beaten, wounded or killed. But this opposition eventually died away, and now the education of the colored children goes on without let or hindrance. The amount expended by the various benevolent societies in the maintenance of these schools can only be stated approximately. In the ten years ending October, 1871, the American Missionary Association reported an expenditure for this purpose of $1,563,756.99. The Freedmen's Aid Society of Cincinnati, before it was merged in the American Missionary Association, $134,340.53, beside large amounts of clothing; the General Assembly of the Presbyterian Church, for five years ending May 1, 1872, $220,704; the American Baptist Free Mission Society, from 1862 to 1870, when its organization ceased, about $165,000; the American Baptist Home Mission Society, in all about $260,000; the

Unitarian Association, directly and through the Zion Methodist Church, over $100,000; the Methodist Episcopal Church, about $110,000; the Friends, directly and indirectly, over $150,000 (including a considerable amount of supplies and clothing); the Protestant Episcopal Church, not far from $80,000. The Freedmen's Department of the Western Sanitary Commisson also expended large sums in aid of these schools in the Mississippi Valley. The Freedmen's Bureau, from May 20, 1865 to October, 1871, expended in cash on these schools $4,711,235.04, and in other things than cash $1,551,276.22. The Catholics have also expended very considerable sums for the establishment of schools for freedmen, and have organized a system of schools for colored children; and there have been many private enterprises sustained by individual contributions, which are not reported. Taking into the account all these sums, together with what had been done by the Freedmen's Bureau, the expenditure for the education of freedmen (including a small amount for refugees and poor whites) has exceeded nine millions. This is aside from the endowment which has been given generally by bequest to several schools of higher education for colored youth—such as the Howard University at Washington, Lincoln University at Oxford, Va., Leland and Straight Universities at New Orleans, Alcorn University at Jackson, Miss., Fisk University, Nashville, Tenn., the Hampton Normal and Agricultural Institute at Hampton Roads, Va., and Atlanta University, Atlanta, Georgia. There are in all over twenty of these schools of higher education for young men of color; some of them aiming to give substantially the ordinary college course, others only a limited English and theological course to train those who are expecting to preach to their own race either here or in Africa. The Howard University at Washington has a theological, medical, and law school connected with it. It is but slenderly endowed, $100,000 only being raised for endowment purposes, though it receives in addition to tuition fees considerable sums in annual subscriptions.

The munificent fund for the promotion of education in the South presented by the late George Peabody, the noblest gift ever made by one man to popular education, properly comes under consideration here, as in some of the States grants are made from it for colored schools. Mr. Peabody, who must rank as the greatest benefactor to education in ancient or modern times, and whose large gifts to other objects are stated more at length elsewhere in this volume, visited the United States in 1866, just after the close of the war, and deeply impressed with the condition of the Southern States and the great need of greater facilities for elementary and secondary education, then resolved to devote a portion of his large fortune for this purpose. Having matured his plans, he placed in the hands of trustees bonds and securities of the value of $2,000,000, the interest and a portion of the principal of which, if necessary, was to be used for the promotion of education in the South without regard to race or color. Rev. Barnas Sears, D.D., LL.D., formerly Secretary of the Massachusetts Board of Education, and at this time President of Brown University, was selected by the trustees, with Mr. Peabody's approval, to apply this large sum, and has done so with great wisdom and fairness. In 1869, Mr. Peabody again visited the country, and was so much gratified at the good accomplished by his gift, that he added $1,400,000 more to it. The revenue from this fund, somewhat more than $200,000 per annum, is divided among the schools of the Southern States in such a way as to encourage them to greater exertions, and to confer a lasting benefit on the communities upon which it is bestowed.

### IX. CHURCH AND DENOMINATIONAL SCHOOLS.

In discussing the character and progress of schools of secondary instruction and colleges, we have not given any special account of those institutions which come under the head of Church and Religious Schools, partly because it is a matter of difficulty to separate them from the others, and partly because the greater part of those claiming these specific titles are of comparatively recent origin. In New England, in the early history of the Colonies and States, all the schools were religious. The district or elementary schools had the Bible or Testament for their text-book, almost their only text-book. They read in it, parsed from it, often had their spelling lessons in it, and though they could not prosecute their arithmetical studies from it very well, yet occasionally a knotty problem in figures was drawn from it. The Lord's Prayer, the

Creed, and the Assembly of Divines' Shorter Catechism were taught to the children from the New England primer, and many a hard-headed theologian of the former class acquired his theological training almost wholly in the district school. The Grammar schools were equally religious in their purpose and their teachings, and the colleges all had for their ultimate object and aim the sentiment emblazoned on the first seal of Harvard College, *Pro Christo et Ecclesiæ*—"For Christ and the Church." This was equally true also of Kings (now Columbia) College, New York, and of the two New Jersey colleges at Princeton and New Brunswick. Farther South the collegiate instruction had more of the secular and less of the theological character, but many of the schools were established by particular churches, and taught their doctrines with the studies of a more general character. This was true of the Catholic Conventual and other schools of New York, Pennsylvania and Maryland, the Moravian schools of Pennsylvania and North Carolina, and the schools of the Friends or Quakers. As colleges were organized in the newer States they very generally (except in the case of State institutions and sometimes even then) were under the patronage of a particular denomination, and their faculty belonged to that denomination. Of the 375 nominal colleges in the United States there are not more than thirty which are not directly or indirectly denominational.

Among the schools of secondary instruction nearly all the Female Seminaries, and a large majority of academies and other incorporated schools in which higher studies are pursued, are avowedly denominational in their boards of government and instruction.

### X. PHILANTHROPIC SCHOOLS.

#### (1.) *Schools for Deaf Mutes.*

The first efforts for the instruction of Deaf Mutes in England were made between 1742 and 1760. J. R. Pereira, a Spanish Jew, but long resident in France, and a man of remarkable genius, instructed a considerable number of pupils, in 1743–1760, by what is now known as the method of articulation, teaching them to pronounce words by imitating the motion of the lips as the words were uttered. He communicated to them also instruction in regard to the meaning of these words and their collocation, and was so successful that his pupils conversed freely, and even had copied from their teacher the Spanish accent of French words. His system was unfortunately kept secret, and in the Revolution in France all knowledge of his method was lost. Samuel Heinicke, a German teacher, instructed the deaf and dumb, from 1754 to 1780, also by the method of articulation. There were others before and after these men who had attempted the instruction of deaf-mutes by this plan, but none of them very successfully. In 1755, the Abbé de l'Epée, a French philanthropist, attempted to teach deaf mutes by the natural language of signs, and proceeding from the known to the unknown, to indicate to them abstract ideas by the same method. He also invented a sign alphabet, by means of which they were taught the alphabet and enabled to spell out the words they wished to utter, to those who did not understand the language of signs. His processes, improved greatly by the Abbé Sicard, one of his teachers and his successor, and by Bebian, a pupil of Sicard, are those most generally practiced in the instruction of deaf mutes throughout Christendom. Some of the English schools, and a few of the German however, adhere to the system of articulation which was introduced in England in 1760 by Thomas Braidwood, who may have been a pupil of Heinicke. Braidwood kept his processes a profound secret, suffering none but his immediate family and relatives to know them for 60 years. He died in 1806, and his widow and her grandsons, and other relatives maintained the school and the secret many years. One of the grandsons came to the United States in 1811, under the invitation of a former pupil from Virginia, to establish a school for deaf mutes in that State, but he did not succeed.

The first successful attempt to instruct deaf mutes in the United States was made at Hartford, Conn., in April, 1817. Its history was as follows: In 1814, Rev. Thomas H. Gallaudet, a young clergyman of Hartford, was led by his interest in Alice Cogswell, the little daughter of Dr. Mason F. Cogswell, who had lost her hearing in infancy, to investigate the number and condition of the deaf mutes in the State, and determined to devote his life to the amelioration of their condition. Dr. Cogswell, Ward Woodbridge, David Wadsworth, and other gentlemen in Hartford, furnished the means for a visit to England to learn the best methods of teaching these unfortunates. He sailed for Liverpool, May 25, 1815, and on arriving in England found that the Braidwood family, who held the monopoly of deaf mute instruction in Great Britain, would not give him any training in their processes except on condition that he should pay fifteen hundred dollars, remain from one to three years without salary, as an assistant in their schools, and take a member of the family as a partner in the institution to be established in America. Mr. Gallaudet promptly rejected these terms, and after repeated unsuccessful efforts to obtain more favorable propositions, was about to return to the United States when he met in London the Abbé Sicard, by whom he was invited most cordially to visit his institution in Paris. Accepting the invitation, the good Abbé at once made him acquainted with all his processes of instruction, and after three months of close study, in which the Abbé gave him every possible assistance, he returned to America, accompanied by M. Laurent Clerc, an educated deaf mute, and one of the Abbé Sicard's most successful teachers. A school for deaf mutes was chartered by the Connecticut Legislature in May, 1816, and Messrs. Gallaudet and Clerc traveled extensively to explain the system of instruction and to raise the necessary funds for its establishment. It was opened in rented buildings, at Hartford, in April, 1817, and soon after received from Congress a grant of a township of land in Alabama, when its corporate name was changed to "*The American Asylum for the Deaf and Dumb.*" By careful management this grant produced a fund of over $300,000, which enabled the directors to furnish board and tuition at a very moderate price to pupils from any part of the country. Until quite recently the New England States made appropriations for the support of their deaf mutes whose friends were unable to support them exclusively in this institution.

The American Asylum was prosperous from the first. Mr. Gallaudet, its founder, was a man of rare genius and originality, and possessed great tact and skill in imparting instruction to a class of pupils whom it had been before considered impossible to educate. He was ably seconded by M. Clerc, who retained his connection with the institution for almost fifty years. The teachers whom Mr. Gallaudet drew around him were all men of remarkable ability; and among them such men as William C. Woodbridge, Lewis Weld, Harvey P. Peet, Isaac Orr, William W. Turner, Luzern Rae, Samuel Porter, John A. Jacobs, O. W. Morris, Collins Stone, and others. His two sons, Thomas and Edward M. Gallaudet, have devoted themselves to the development of this class of institutions, and the moral and intellectual culture of deaf mutes.

As this asylum has been directly the parent of all, or nearly all, the institutions for deaf mutes in the United States, and its methods have been followed with, at most, very slight modifications, by all the others, it is perhaps necessary that we should show in what particulars the American methods of deaf mute instruction differ from the European. It was a great blessing to the deaf mutes that the work of establishing a system of instruction for them fell to the lot of a man of such genius and ability as Mr. Gallaudet. Had he been merely a routinist, following implicitly the system of De l'Epée, Sicard, and Bebian, their intellectual culture to-day would be vastly below what it now is.

The system of Pereira, Heinicke, and the Braidwoods had for its basis the dogma that ideas could only be expressed or communicated by means of spoken or written language; and hence the deaf mute was taught, with great difficulty and pains, to articulate words whose meanings he did not understand, and then, as step by step he connected ideas with the simplest of them, these were made the means of conveying to him the meaning of those more abstract and difficult. In this way three or four years were consumed before the pupil was prepared to acquire the facts of science or the knowledge of his moral obligations.

The fundamental principle of the system of De l'Epée, as modified by Sicard and Bebian, was that "words have no natural or necessary connection with the ideas of which they are the signs, and that in the natural language of signs or pantomime, improved and enlarged as it can be, there is a complete substitute for them." No special attempt was made at teaching articulation, but words were taught by means of signs, and these once acquired, were made the medium of further instruction by ordinary text-books. In order to teach words more readily, M. Sicard introduced what he denominated *methodical signs*, that is, a peculiar gesture for each word, which the pupil was taught. It is obvious that if the vocabulary of the deaf mute was to be as large as that of ordinary intelligent speaking persons, the number of these arbitrary signs (for it is to be understood that these differed almost as much from the ordinary signs as the latter from words, the natural signs representing ideas, and the methodical signs single words) must be very great, some thousands at least, and to retain them in memory was a very fatiguing task for both pupil and teacher.

The American system of deaf mute instruction differs materially from both these, and the difference originating in its fundamental principles with Mr. Gallaudet and the teachers trained up under him, has been extended and amplified as a result of the experience and observations of the very eminent teachers who have been and still are engaged in the work of deaf mute instruction.

In establishing the American Asylum, Mr. Gallaudet combined the principle of Heinicke, of the connection of ideas with words, with that of De l'Epée, that the natural language of signs must be elevated to as high a degree of excellence as possible in order to serve as the medium for giving the ideas clearly and explaining them accurately; but he added to these another which had never before been applied to deaf mute instruction, viz., that the process of learning words might be greatly facilitated by leading the pupils to reflect on their own sensations, ideas, and mental processes. With the earliest lessons he imparted in the names of sensible objects, he was accustomed to endeavor to open communication with them, by means of the sign-language, in regard to the feelings and emotions excited by these objects, and, if possible, to connect them with something in the pupil's past experience. From this, the deaf mute was naturally led on to think of the feelings and emotions of others, thence, by a natural transition, to the idea of God as a Creator and benefactor, and finally to a knowledge of his law, and the final destiny of man. The result of this has been that pupils in this country (for this plan has been generally adopted in our American institutions) are made acquainted with the simple truths of religion and morality in one year, a period in which, in the European institutions, they have scarcely advanced beyond the knowledge of sounds and the names of sensible objects, qualities, and actions, or the most common phrases. Apart from the high religious importance of this process, it brings moral motives to bear earlier, and renders the government of the pupils easier, while it aids them in the formation of correct habits. The conducting of the daily and weekly devotional exercises in the sign-language was another peculiarity introduced by Mr. Gallaudet.

Methodical signs were used to a considerable extent by Mr. Gallaudet and the earlier instructors of American institutions, but were not regarded as so indispensable by them as by the French teachers. Of late years they are less employed than formerly, and are made to indicate phrases rather than words, while the manual alphabet is regarded as of more value in teaching than it was thirty years ago. An advance has also been made, of great importance, by the introduction, by Mr. I. Lewis Peet, of the New York Institution, of manual and written symbols for those ultimate constituents of the sentence which form so considerable a portion of spoken and written language. By this means written language is taught with much greater facility than formerly. The idioms and forms of expression induced by the use of the natural language of signs, differ so much from those of our written language, which is to a greater extent than most people are aware, artificial in its construction, that it has been difficult for deaf mutes, in attempting to obtain a higher education to attain to that complete mastery of English, which is acquired with comparative readiness, by those who have not the idioms of a native language to unlearn; for to the deaf mute this natural language is in some sort their mother tongue.

The New York Asylum was chartered in April, 1817, mainly through the active exertions of Drs. S. L. Mitchell and Samuel Akerly, DeWitt Clinton, Sylvanus Miller, Peter Sharpe, and Rev. Dr. James Milnor, It was not opened till May, 1818, and the first twelve years of its history were years of struggles and difficulties, partly from the lack of competent teachers and assistants, and partly from injudicious management. In 1830 it was removed to buildings specially erected for it on the block between 49th and 50th streets, and Fourth and

Madison avenues, and Mr. (afterward Dr.) Harvey P. Peet, one of the ablest of the teachers of the American Asylum was elected Principal. Dr. Peet had much to contend with at first, but he was grandly successful, and the present asylum on Washington Heights, overlooking the Hudson, with its noble buildings and its fine park of thirty acres, with accommodations for six hundred pupils and every advantage for successful instruction, is a monument to his ability and fidelity both as a teacher and executive officer. Dr. Peet remained at the head of the institution till 1867, when he resigned, and his son, Isaac Lewis Peet, was elected his successor; but he retained his official connection with the institution until his death, January 1, 1873, The number of pupils in 1871 had reached 580, under 30 teachers.

The Pennsylvania institution was founded at Philadelphia in 1820, and in 1822 Mr. Lewis Weld, another of the Hartford teachers, became its principal. In 1830, on Mr. Gallaudet's resignation as principal of the American Asylum, Mr. Weld was recalled to Hartford as his successor, and was succeeded at Philadelphia by Mr. Abraham B. Hilton, who proved a highly successful teacher for 40 years, until his death in 1870. The institution has been prosperous from the start.

The Kentucky institution was founded in 1823, and located at Danville. It received a grant of public land from Congress, but no considerable fund was realized out of it. Its first principal, who was at its head for forty-five years, was Mr. John A. Jacobs, who was previously one of the teachers of the American Asylum. At his death, in 1868, his son succeeded him.

The Ohio institution, founded in 1827, has been very prosperous. Its first and third principal, Messrs. Hubbell and Stone, were from the American Asylum, and its second, Mr. Cary, from the New York Institute, who was succeeded in 1855 by Mr. Collins Stone, at the time a teacher in the institution at Hartford, to which he returned to become principal in 1868, and where he died in 1871.

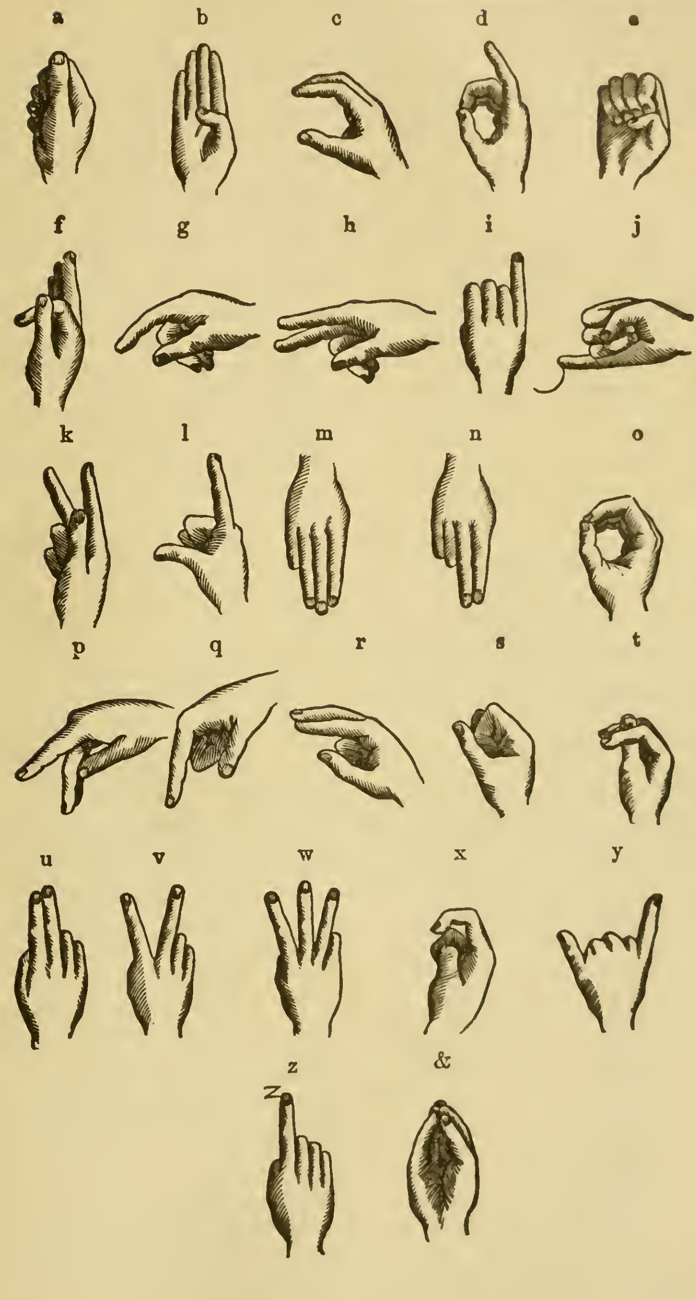
The Virginia institution, at Staunton, Va., founded in 1839, and long officered from the Hartford institution, was the first in this country to combine the instruction of the deaf mutes and the blind under one board of officers and teachers. There are now nine asylums in the United States where these two classes are educated together.

There are in the United States thirty-eight distinct schools or institutes for Deaf Mutes, five or six of them, however, are small, and three day schools in Chicago, Boston, and Pittsburgh; two or three teach by the system of articulation only, while most of the others give instruction in articulation to classes of semi-mutes, *i. e.*, those who have learned to speak but have become deaf in childhood. For those who were deaf and dumb from birth, the ablest teachers believe the time spent in teaching articulation can be spent in acquiring ideas and and the power of expressing them. What will be the ultimate result of the general use of the Bell system of Visible Speech, introduced into the Clarke Institution at North Hampton, and to a limited extent in the American Asylum at Hartford, and the private school of A. Graham Bell at Boston, since 1871, can not be safely predicted. With a class of semi-mutes, it proves highly useful in facilitating articulation.

Twenty-nine of the States, and the District of Columbia, have each one or more institution for the deaf and dumb. In most of these the course of instruction occupies seven years, and those who are unable to pay their board and tuition are supported by the several States. In the American Asylum and the New York institution an advanced course occupying three years was established in 1854; and in 1864 the National Deaf Mute College was organized, as a department of the Columbia institution at Washington. It has the usual college classes, with a course of study occupying four years, closely following that of our best colleges. The success of the institution in Washington, and the establishment of the National College, is mainly due to a son (E. M. Gallaudet, LL.D.) of Thomas H. Gallaudet.

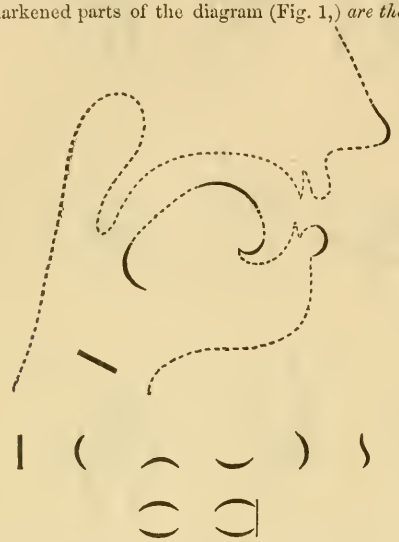
By the census of 1870, the number of deaf and dumb persons in the United States returned that date (July, 1870,) is 16,205, of whom 14,869 were native, and 1,336 of foreign birth. This is probably considerably below the actual number, which is probably not much below 20,000, or one to every 2,000 inhabitants. Of these 4,000, or a fraction more, were under instruction at that time, probably nearly all who were of school age—for the per centage of illiterate deaf mutes is very small.

# ALPHABET OF THE DEAF AND DUMB.



In 1865, Mr. A. Melville Bell, Professor of Vocal Physiology in England, announced in a pamphlet entitled "*Visible Speech: A New Fact Demonstrated*," that he had discovered the true organic relations of speech sounds, and had invented a universal alphabet based upon his discovery. His new method of writing he termed "Visible Speech," from a peculiarity in the formation of the letters. In this method, every letter, and every part of a letter, has a definite physiological meaning. The elementary lines and curves are pictorial of parts of the mouth; and these are capable of being grouped together into a compound form, just as the various parts of the mouth are arranged in uttering sound. In this way, the inventor claimed he could represent any sound the human voice could make, so that another person should be directed how to utter it. The following diagrams will illustrate the elements of this Alphabet.

The darkened parts of the diagram (Fig. 1,) *are the Visible Speech symbols* for the organs of which they are the outlines. These symbols are written separately, and in one line, at the lower part of the diagram. They indicate respectively, as they stand, beginning at the left hand, the throat, the back of the tongue, the top of the tongue, the point of the tongue, the lower lip, and the nose.



The sign for the throat, (the straight line) represents a mere chink or slit in the throat, and is pictorial of the vocalizing condition of the glottis. It is therefore used to denote "voice."

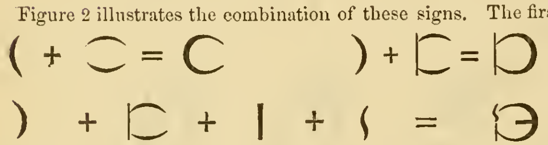
The sign for the nose is, in reality, pictorial of the uvula, the pendulous extremity of the soft palate. When the soft palate is depressed, the breath passes up behind it, and escapes through the nostrils. When it is raised, the communication between nose and mouth is cut off.

Hence the application of a symbol originally pictorial of the soft palate to the nose.

Its strict scientific meaning is,—"soft palate depressed;" but it will be more popularly understood as "air passing through the nostrils."

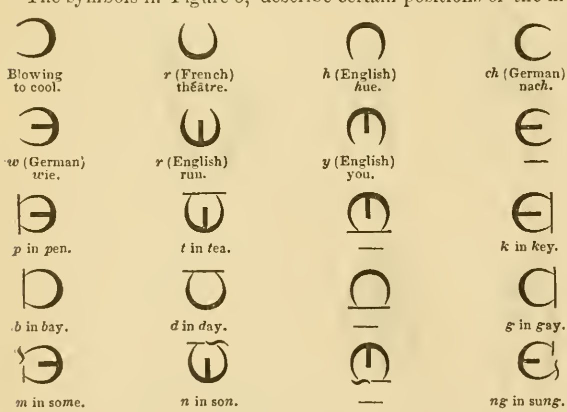
At the lower part of Fig. 1 are two additional symbols, like parenthesis laid horizontally. The first of these is intended to convey the idea of a *pipe;* and the second exhibits this pipe *closed at one end.* The first is used to denote a *narrow passage in the mouth,* through which the breath may pass; and the second, *complete closure of the passage.*

Figure 2 illustrates the combination of these signs. The first compounded symbol indicates "a narrow passage" for the breath, over (plus) the "back of the tongue." The combination indicated by the plus sign stands after the sign of equality, being a crescent protracted to three-fourths of a circle. This is the position of the mouth in sounding *ch* (German), in the word *nach.*



The second symbol (lip *plus* closure) directs us to "close" the "lips." This position is assumed by the mouth in uttering a word commencing with *p,*—*e. g.,* paper. The third symbol (lip *plus* closure *plus* voice *plus* nose) indicates that the "lips" are to be "closed," and the voice passed through the "nose."

The symbols in Figure 3, describe certain positions of the mouth which yield sounds. The reader can, it is presumed, readily analyze them from the preceding figures.




Key words are so variously pronounced by different speakers, as to be, in many cases, worthless as a means of identifying sounds.

They are, therefore, omitted in the present instance, except in those cases where they will be likely to assist the reader.

The fact that the Visible Speech symbols exhibit to the eye all the relations the sounds themselves do to the ear, and that the organic relations are just as clearly shown, will be obvious by a comparison of the characters for

| | | |
|---|---|---|
| P | B | M |
| T | D | N |
| K | G | NG. |

Comparing these as thus placed, Visible Speech and its signs say that—

As P is to B, so is T to D, and K to G.
As B is to M, so is D to N, and G to NG.
As P is to T, so is B to D, and M to N.
As P is to K, so is B to G, and M to NG., &c., &c.

P, B, and M have the "lip" and "shut" signs in common; and in sounding all, the lips are shut.

T, D, N, agree in shutting off the breath by means of the point of the tongue, and K, G, NG, in the closing action being performed by the back of the tongue.

Furthermore, the sounds P, T, K (represented by the same symbol turned in different directions), are made by the same organic action performed at different parts of the mouth; so with B, D, G, and M, N, NG.

(2.) *Schools and Institutions for the Instruction of the Blind.*

The instruction of the blind had never been attempted on any considerable scale, in any part of the world, before the Abbé Valentin Haüy, in 1784, commenced in Paris, France, his private school for blind pupils. Individuals who were blind had indeed educated themselves by the assistance of friends; but the great majority of those who suffered from this affliction were left to a life of dependence and depression, and often became beggars. The efforts of Haüy, and his invention of an embossed alphabet, to enable the blind to read, led to the foundation of a school for the blind in Paris, supported by the French government, in 1791, and to the organization of similar schools in England, Prussia, Austria, and Russia, about the same period. In these schools, reading and music, and some of the simpler mechanic arts, such as knitting, mat-weaving, basket-making, etc., were taught.

The first systematic efforts for the education of the blind in the United States were made in Boston in 1829. Dr. John D. Fisher, a young physician of that city, while studying his profession in Paris had visited repeatedly the Institute for the Blind, and was inspired with the determination to attempt their instruction at home. On his return to America he associated himself with a half-dozen benevolent gentlemen of Boston, among whom was William H. Prescott, the eminent historian, who was himself partially blind. These gentlemen having heard Dr. Fisher's narrative of what had been accomplished in the institution at Paris, procured from the Massachusetts Legislature in March, 1829, a charter for an institution to be called "The New England Asylum for the Blind," and at once undertook to raise money for buildings and endowment. The gift by Col. Thomas H. Perkins of his valuable mansion house and lands in Pearl street, Boston, to the asylum, on condition that $50,000 should be raised by others, soon led to its liberal endowment, and to the change of its corporate name to "The Perkins Institution and Massachusetts Asylum for the Blind." It was not formally opened until 1831, when Dr. Samuel G. Howe, another young physician of Boston, who had been actively engaged in extending succor to the Greeks in their efforts to throw off the Turkish yoke, and who passing through Paris on his return from the East, had devoted careful attention to the methods of the French Institute for the Blind, took charge of it, and has continued in its superintendence for more than forty years. The institution received grants from the Massachusetts and other New England Legislatures in proportion to the number of beneficiaries received. These grants now amount to about $37,000 per annum. The genius and ability of Dr. Howe in the management of the institution, and in inspiring other men with his own enthusiasm, and his remarkable success in educating Laura Bridgeman, a blind deaf mute, has secured for the institution the continued support of the benevolent and the Legislature, for all needful modifications of the system.

In 1831, Dr. Samuel Akerly, already well-known for his efforts in behalf of the deaf and dumb, Mr. Samuel Wood, a benevolent member of the Society of Friends, and several other gentlemen of New York, became interested in the condition of blind children in the alms-house, and made application to the New York Legislature for an act of incorporation for an institution for for the blind, which was granted. Securing the services of Dr. John D. Russ, another young physician whose aggressive benevolence, like that of Dr. Howe, had enlisted him in the cause of the Greeks, they commenced at first in a very humble way the instruction of the blind pauper children in the city of New York. This institution, like that of Boston, has grown to be one of the largest in the world. Dr. Russ withdrew from its superintendency after a few years, but is still its warm and efficient friend.

In Philadelphia, Robert Vaux, a wealthy and benevolent Friend, and others who were like-minded, after two or three years of exertion succeeded in 1833 in establishing an institution for the blind, which was at first under the charge of an able and intelligent Prussian, Mr. Julius Friedlander, who had been one of the teachers of the blind in Berlin under the direction of the celebrated Zeuné. Mr. Friedlander's death, in 1839, was a severe blow to the institution, and for the next ten years, under a variety of superintendents, it did not attain to a great success, but with the appointment of its present able and efficient superintendent, William Chapin, LL.D, it commenced a new career, and is now second to no institution for the blind in the world in its successful management, and the great amount of good it is performing. It has connected with it an Industrial Home for the Blind, intended for the infirm and aged as well as for those who are capable of partially supporting themselves. It is open under certain restrictions to graduates of blind institutions—those of the Philadelphia institution having the preference. The pupils of the Philadelphia institution are very well educated in music, and its weekly concerts are largely attended by the best musical connoisseurs of the city, and have proved a considerable source of revenue.

In 1837, the Ohio institution was established at Columbus, and though passing through many changes and vicissitudes, it now takes a high rank. The department for the blind in the institution for the deaf, dumb and blind at Staunton, Va., was organized, January, 1840. Between 1842 and 1850, six more institutions for the blind were established, viz., the Kentucky Institution at Louisville in 1842, the Tennessee Institution at Nashville in 1844, the North Carolina Institution at Raleigh in 1846, the Indiana Institution at Indianapolis in 1847, the Illinois Institution at Jacksonville in 1849, and the South Carolina Institution for the Deaf, Dumb and Blind at Cedar Springs the same year. The Wisconsin Institution was founded at Janesville, in 1850. There are now twenty-seven of these institutions in the United States, having an aggregate of about 2,200 pupils.

The whole number of blind persons in the United States, according to the census of 1870, is 20,320, of whom 17,043 are natives and 3,277 of foreign birth. This includes, of course, many persons who have become blind in adult age, and who therefore were not suitable candidates for instruction in this class of institutions. Still it is believed that the proportion of blind youth who receive instruction to the whole number is not nearly so great as of the deaf mutes. Begging is so ready and profitable a resource for the blind that a very considerable proportion, especially of those of foreign birth or parentage adopt it. The table appended gives many particulars in regard to the blind institutions in this country.

The education of the blind in the European institutions is for the most part confined to the mere rudiments of knowledge except in music, which is in some of them taught very successfully. They are generally instructed in some handicraft by which they may partially or wholly support themselves. In the United States, while the technical and musical education have not been neglected, they are generally very well taught in the studies which belong to what we are accustomed to call secondary education. The period of instruction varies in the different institutions from five to eight years. In most of the larger and older institutions it is eight years, and includes a course of mathematics and belles-lettres, but does not usually include the languages, though in two or three French is taught. There is usually much attention given to musical instruction, both vocal and instrumental, for which most of the blind possess a remarkable aptitude. Work-rooms are attached to all the institutions, in which the pupils are employed for some hours every day in the manufacture of mattresses, mats, tidies, baskets, paper-boxes, brooms, brushes, or the simpler articles of cabinet work.

The first efforts of the American instructors of the blind were devoted to the improvement of the alphabet of raised letters, used in printing for the blind, with a view to the preparation of books for them. There were considerable difficulties to be overcome in the accomplishment of this work; the letters must have salient angles; each letter must differ sufficiently from every other to be easily recognized by the touch; yet the size of the letters must be small, or the books printed for the blind would be too cumbrous and expensive. The forms of letters used in Europe did not answer these requirements satisfactorily. Haüy's type, if well embossed, could be read with tolerable facility, but it was much too large, and its size could not be reduced without impairing its legibility; Guillié's was not legible at all; Gall's varied too much from the ordinary form of letter to be desirable, and the other attempts at uniting the requisite qualities failed. Each of the three American superintendents devoted his leisure to the work. Mr. Friedlander devised an alphabet, known in England as the Allston or Sans-serif Alphabet, neat in form and easily read, but somewhat too large; Dr. Russ invented one combining the advantages of Gall's triangular alphabet with the Illyrian letter, and with characters to make it phonetic, but it was somewhat defective in legibility; and Dr. Howe, after repeated trials, constructed what is now known as the Boston letter, which in size, distinctness, and legibility so far surpassed every previous effort, that it has now come into general use in Europe and America.

The great cost of printing, or rather embossing, works for the blind has rendered the supply scanty, and the number of books small. The American Bible Society has printed an edition of the Scriptures in the Boston letter, a benevolent gentleman having made a bequest to cover the cost of the plates, and from time to time grants are made to institutions for the blind. The American Tract Society has also printed a few of its smaller books in the same letter. Aside from these there are less than one hundred books printed or embossed for the blind. Among this small number are some text-books, a cyclopædia to be completed in twenty volumes, but not yet, we believe, quite finished, some volumes of poems, &c.

Owing, probably, to their high cost and great bulk, the blind after leaving the institutions seldom use any of the books in the raised letter except the Scriptures, their tenacious memory enabling them to retain most of what is read to them by others.

Writing has always been a difficult and irksome task to the blind; and various devices have been proposed to facilitate this labor, but hardly any of them have proved satisfactory. The plan adopted by the late William H. Prescott of using a frame of wires over the paper, enabled him to write in straight lines, but no corrections could be made, nor could the scribe read what he had written. The use of inks which would leave an elevated surface has been tried, but without much satisfaction; small printing machines have also been used, but are not convenient.

Within a few years past another process has been introduced, which, despite the apparent objections to it, proves far more serviceable and convenient than any other yet devised. By this invention, known as "Braillé's system," from its inventor, M. Louis Braillé, a French teacher of the blind, or rather by an American modification of it, they are soon enabled to read and write with great facility, and by the addition of a single character, music can be printed or copied by the blind far more readily than a seeing person can do it in the ordinary way. The plan is based upon a series of fundamental signs, comprising the first ten letters of the alphabet; none of these consist of less than two nor more than four dots. A second series is formed by placing one dot at the left of each fundamental sign; a third by placing two dots under each sign; a fourth by placing one dot under the right of each. These signs designate, besides the alphabet, the double vowels, peculiar compound sounds like *th*, and the marks of punctuation. By prefixing a sign consisting of three dots, the fundamental signs are used as numerals; by prefixing another the last seven represent musical characters, and by a sign peculiar to each octave the necessity of designating the key to each musical sentence is avoided. It consists of a board, in a frame like that of a double slate, the surface of which is grooved horizontally and vertically by lines one-eighth of an inch apart; on this the paper is fastened by shutting down the upper half of the frame, and the points are made with an awl or bodkin, through a piece of tin perforated with six holes, an eighth of an inch apart. The perforations are made from right to left, in order that the writing when reversed may read from left to right. Books and music are now printed for the blind on this system. Most of the larger institutions have adopted it.

Dr. John D. Russ, the first superintendent of the New York institution, has invented an "improved Braillé system," which seems to possess some advantages over this, but it has not been adopted, so far as we have learned, by any of the schools for the blind.

Attempts have been made to furnish employment on a large scale to the blind and pay wages which should be sufficient for their support, or equalize their condition with that of seeing persons engaged in mechanical labor; but such efforts have always failed, and in the nature of the case must do so; for the deprivation of sight, though partially compensated by the greater activity of other senses, is too serious a defect to allow the blind an even start in the race for a livelihood with the seeing, and so long as the rate of wages are such that only an exceptionally active and enterprising mechanic, who has his eyesight, can make anything more than a livelihood, the blind, laboring under so many disadvantages, must necessarily fall behind in the race.

(3.) *Institutions for the Education and Training of Idiots and Imbeciles.*

These institutions are wholly the outgrowth of the philanthropy of the nineteenth century. No successful attempt had ever been made before the year 1838 to rouse and bring into activity the arrested mental development of the idiotic child. It is true that the benevolent and philanthropic St. Vincent de Paul, the founder of the order of Lazarists, gathered into his monastery a number of idiotic and imbecile youth, and by care and tenderness sought to improve their wretched condition, but he had no idea of their real condition or of the principles on which alone a successful treatment of their cases was possible. Itard, Pinel, Esquerol, and other names illustrious in psychological science, had all grappled with this difficult problem of the true method of reaching the idiot and raising him up to self-control, and all had failed. It was reserved for a young French physician, Dr. Edouard Seguin, a pupil of Itard, to solve this problem. He gathered a few idiotic children in Paris, and proceeding on the principle that idiocy was an arrested development, a prolonged infancy, in which the infantile grace and intelligence having passed away, the feeble muscular development and mental weakness of that earliest stage of growth alone remained, he questioned nature as to her processes of development of the infant, and of elevation and education of the physical, mental, and moral powers. He found in idiot children the infantile fondness for bright colors, and availed himself of it to teach them the distinctions of color and form; he noticed their liking for playthings, and furnished them with builders' blocks, cups and balls, and other toys, by which he could instruct them in numbers, shape, and size; he developed volition, by simple physical movements, by molding the hand to grasp objects, the lips to utter sounds, by moving the lower limbs up, down, backward, forward, and laterally, by compelling them to take a step or raise hand or foot, at a signal or word of command; by the use of dumb-bells, and an infinite variety of processes repeated almost an infinite number of times; then words were taught with the aid of pictures, and new ideas, at first concrete, and afterward those of an abstract character, were instilled into their minds as fast as they could comprehend them. With all these, and beyond them, the moral nature was gradually roused by the simplest instruction and the influence of a pure example. The process was slow, and the difficulties to be conquered many, but Dr. Seguin persevered and triumphed. His processes were submitted to the most careful scrutiny by a committee of the French Institute, and by numerous teachers and psychologists who had become interested in it; but all resulted in the conviction that he alone had hit upon the philosophic and only practicable mode of rousing and developing these dormant natures. He continued to teach idiotic children in Paris with great success for ten years, and published several works on the subject of their education. His "Moral Treatment, Hygiene, and Education of Idiots," published in 1846, was recognized by all psychologists as the ablest and most philosophical work on that subject. In 1848, Dr. Seguin came to the United States, and of his labors here we shall speak further on. In 1836, Dr. Louis Guggenbühl, a Swiss physician, commenced his experiments on the education and training of cretins in Switzerland; the cretin being a somewhat deformed and physically helpless creature, his mental and moral development arrested in consequence of disease, impure air and water, but really a more tractable subject than the idiot. These experiments were conducted on the Abendberg, near the Interlaken, for fifteen or twenty years, with considerable success, and a number of institutions for cretins were started; but Dr. Guggenbühl seemed to fail in comprehending the true principle of rousing these cases of arrested development, and after a time his institution was given up, and some of his cretins went back to their old life of squalor and mendicity. In England and Scotland the fruits of Dr. Seguin's philosophical treatises and successful teaching were seen in the organization of schools and asylums for idiots at Highgate, Colchester, Baldovan, Edinburgh, and elsewhere.

In the United States, attention was first called to the subject by the eloquent letters of Mr. George Sumner to one of the Boston papers, describing his visits to the schools of Dr. Seguin and M. Vallée, in Paris. These letters were published in 1845, and the attention of Dr. S. B. Woodward, of Worcester, Dr. F. F. Backus, of Rochester, N. Y., and Dr. S. G. Howe, of the Blind Institution at Boston, were called to them.

Dr. Backus, then a State senator in the New York legislature, brought in a bill to the Senate for the establishment of an institution for the training of idiots, during the session of 1846, and Dr. Howe procured the appointment of a commission to investigate the condition of idiots in Massachusetts, the same winter. Both these movements eventually resulted in the establishment of institutions for the training of idiots.—in Massachusetts in 1848, and in New York, by reason of opposition, not until 1851. Meantime a young physician of Barre, Mass., Dr. Hervey B. Wilbur, had opened a private school for idiot children in his own house, in July, 1848, and was endeavoring to put in practice the principles of Seguin. The Massachusetts Experimental School, which in 1851 became a permanent "School for Idiotic and Feeble Minded Youth," was first organized in South Boston in October, 1848. As we have said, Dr. Seguin visited the United States in 1848, and after spending a little time at South Boston and at Barre, returned to France, but in 1851 came again to this country, which has since been his home. The New York institution, started at Albany in 1851, was organized by Dr. Wilbur, who has been for almost twenty-two years (1873) its head, while Dr. George Brown succeeded him at Barre. The presence and aid of Dr. Seguin in these schools at their beginning was of inestimable value. He imbued the superintendents and teachers with his enthusiasm and patience as well as with his principles of education, and the really remarkable success of the American schools for training idiot children, a success vastly greater than has been attained in other countries, is due, in large measure, to the admirable works and still more admirable drill of the teachers and pupils in their presence, by Dr. Seguin. Undoubtedly he found in these teachers and superintendents those who were apt to learn, and who possessed the ability to carry out successfully the principles which he had imparted; but very few have the good fortune to be instructed by so skillful a teacher. After devoting several years to the promotion of these institutions, and the still wider introduction of the physiological method of education, Dr. Seguin settled in the practice of his profession, at first in Portsmouth, Ohio, and subsequently in New York city; but that he has not lost his interest in the education of idiots is evident from his publications on that subject—"Idiocy and its Treatment by the Physiological Method" (1866); and "New Facts Concerning Idiocy" (1868). He is now engaged in applying the same principles to the education of children generally.

The "Pennsylvania Training School for Feeble Minded Children," at Media, was organized at first at Germantown, in 1853, by Mr. J. B. Richards, who was for a time a teacher in the South Boston school, and was assisted, after its establishment in the building erected by the State for its accommodation at Media, by Dr. Seguin. It is now one of the largest of this class of institutions.

The Ohio Asylum for Imbecile and Feeble Minded Youth," at Columbus, was founded in 1857, and the Kentucky Institution, at Frankfort, about the same time. The Connecticut Institution (private), at Lakeville, was opened in 1858, by Dr. Knight; and the Illinois Asylum for Idiots, at Jacksonville, in 1865. There are now in actual operation, under State organization or aid, nine institutions, and others will soon be formed.

Dr. Seguin lays down in his work on "Idiocy" a distinction which is worth observing, viz., that the imbecile, though apparently more promising, is really a more hopeless subject for treatment than the helpless and wholly undeveloped idiot. Epilepsy too, which often accompanies imbecility, and sometimes idiocy, is an almost fatal barrier to improvement. It is, then, an encouraging result that, taking, as the State institutions do take, all classes, from seventy to eighty per cent. are very greatly improved, and from twenty-five to thirty per cent. become self-supporting, and as intelligent and sound of mind as the average of working men. Several have distinguished themselves by fidelity and good conduct in very trying positions. About 3,000 have been dismissed as decidedly improved and benefited since the opening of these institutions, and more than nine hundred are now under instruction.

The census of 1870 gives the whole number of idiotic persons in the United States as 24,527, but on this subject the returns are not very reliable. The demented and fatuous are included, and probably also many who, though, to use an old Saxon word, *underwitted*, are yet far from being idiotic. On the other hand, many eccentric, feeble-minded, and perhaps really idiotic children, are omitted in consequence of the pride and sensitiveness of parents and friends. The table appended gives many particulars of the Idiot Asylums.

(4.) *Hospitals and Asylums for the Insane.*

We shall not discuss here the influence which Education exerts in producing or increasing insanity; that it does exert some influence to that effect is universally admitted; but it will be found to be mostly in two directions; one, where the culture of the faculties is not uniform in its character, and the mind is, consequently, not well balanced, some faculties being overstrained, and others comparatively undeveloped; the other, where from too close application, or inordinate ambition for acquiring knowledge, the physical powers are neglected, and disease or infirmity of the body, induced by insufficient exercise and recreation, communicates itself to the overwrought brain and causes the worst and most hopeless form of insanity. We do not believe, however, that hard study ever killed a man or made him insane unless it was coupled with violation of the physiological laws of life and health.

But it is not these connections of insanity with intellectual culture that we have here to discuss. We are only called to notice the instances, still rare, though much more common than they were, where the prosecution of some studies, the exercises of a school, or the use of what may be called educational appliances or adjuvants, have been resorted to as means of "ministering to a mind diseased;" and, we may be pardoned if we allude incidentally to the great and beneficial influence which the wide diffusion of education, especially of scientific education, has had in the amelioration of the treatment of the insane, within the past fifty years.

The cruelty with which the insane were treated from fifty to eighty years ago may well excite our wonder and horror. The poor unfortunate, bereft of reason, was, while in that condition, an object of both terror and loathing; the notion had gained credence that the mortification of the body by whipping and beating was the readiest cure for the affliction, and blows and lashes were rained upon him till his tormenters were weary with their exertions; the poor victim was chained, exposed to the intense cold of winter and the equally intense heat of summer with but scanty and filthy raiment; their food was coarse and repulsive, and their whole condition one fitted to excite the pity of the hardest heart. The few asylums for lunatics, and they were very few in this country, resorted to chains and handcuffs, to harsh treatment and prison fare, though they were better than the almshouses, jails, and private pens in which the great mass of the insane were confined. But under the lead of Dr. Eli Todd, in the Connecticut Retreat for the Insane, in 1823, a wiser system of treatment was inaugurated, and the blessed results of kindness and tenderness, combined with a better knowledge of the nervous system, and its connection with the abnormal manifestations of insanity, has revolutionized the condition of institutions devoted to this class of unfortunates. Great efforts have been made within a few years past to draw the thoughts away from the delusions and hallucinations connected with its disordered condition, and to cause it to occupy itself with some form of study or mental exercise. In some of the Insane hospitals there are classes, where often both teacher and taught are patients; in others there are courses of scientific lectures; in others the study of our own literature and that of other nations is encouraged; some pursue art studies, or practice drawing, painting or designing; others are pursuing philological studies; for still others, physical science in some of its branches is a favorite pursuit; while to many horticulture, the care and rearing of plants and flowers, or the exercises and games of the gymnasium, afford the needed recreation. Libraries and reading-rooms have come to be a necessity for these hospitals, and in most cases nearly all the patients avail themselves of them. One result of this great change in the methods of treatment has been to increase greatly the number of cures of insane persons. Another apparent but probably not real result has been the increase of the number of insane patients. New Asylums or Hospitals for the insane are constantly erected, and no sooner are they completed than they are filled to overflowing. Yet it is not so much that there is such a rapid increase in the number of the insane, as that old cases, hitherto concealed, are constantly coming to light, under this humane treatment. There is undoubtedly a considerable increase in the number of the insane, the ratio of increase being probably somewhat greater than that of the general population, a consequence of the existing fast, pushing life of our people; but many thousands of the insane are now treated in hospitals, who, under the old regime, would have been concealed in their homes, and their disease, and even their existence hardly known to the most intimate friends of the family. The great desideratum now is a Training School for attendants and nurses for this class of patients, as was suggested by Dr. Todd in 1830, and the introduction of Charitable Orders into their management, like that which has charge of the Mount Hope institution near Baltimore, Maryland.

The census of 1870 gives the whole number of insane persons in the United States as 37,382, of whom 26,161 are natives and 11,221 of foreign birth. This is probably not far from the truth, certainly not in excess of it. The number of insane hospitals in the United States in 1870 was 58, and four or five have been opened since. The number of patients was in 1870 15,598. It is probably now (1873) at least 17,000. Very many incurable cases, where the insanity is of a mild type, are at large, and many more are in alms-houses. In Massachusetts and New York, as well as in some of the Western States, there are in many of the larger alms-houses departments for incurable insane paupers.

### XI. PREVENTIVE AND REFORMATORY SCHOOLS AND INSTITUTIONS.

Although there are occasional indications that individual philanthropists, like the benevolent Cardinal Odescalchi at Rome, and Sir Matthew Hale in England, had clear perceptions of the evil of leaving vagrant and morally endangered children as well as juvenile delinquents, exposed to the temptations to a vicious life, yet apart from a school established partially for them by the former in 1586, there seems to have been no serious movement in their behalf prior to the establishment of the school and home for vagrant and vicious boys at Rome, by Giovanni Borgi, (better known as Tata Giovanni, or Papa John,) in 1786 or 1787, and the organization of the "Philanthropic Society for the Prevention of Crime" at London in 1788. This last, originally established on the family plan, soon became a large establishment, in which a great number of boys were congregated and employed in different branches of manufacture, having also a probationary school of reform for the more vicious and criminal of its inmates. In 1846, a large farm was purchased at Red Hill, near Reigate, Surrey, agriculture and horticulture were substituted for mechanical and manufacturing pursuits, and the family system for the congregated. Since that period the number of family reformatories, as they are called, has greatly increased in Great Britain. On the continent the eminent success of the agricultural and horticultural reformatories of Mettray, Horn, Ruysselede, and many others of more recent origin, has attracted general attention.

In this country the first institution intended for the reformation of vicious and criminal children, was the "New York House of Refuge for Juvenile Delinquents," incorporated in 1824, and opened January 1, 1825. Its founders were John Griscom, Isaac Collins, James W. Gerard, and Hugh Maxwell, all at the time members of a "Society for the Prevention of Pauperism and Crime," which had been formed in 1818. The institution thus founded has had a steady growth, as the rapid increase of population in the city has been attended by a more than corresponding augmentation of the number of juvenile delinquents. At the end of forty-eight years from its first opening it occupies a tract of thirty-seven and a half acres on the southern end of Randall's Island, in the East River, and its colossal buildings, erected at an expense of over five hundred thousand dollars, furnish ample accommodations for school-rooms, lodging-rooms, dining-rooms, and workshops for 1,000 children, and usually have in the institution more than 900.

In 1826, a "House of Reformation," on a similar plan, was established in Boston, and, in 1828, a "House of Refuge" in Philadelphia. Similar institutions have since been organized in New Orleans, Rochester, N. Y., Westboro', Mass., Cincinnati, Providence, Pittsburg, West Meriden, Conn., St. Louis, Baltimore, Louisville, and perhaps some other points in different States.

The distinguishing characteristics of these institutions are, that those committed to them have generally been arrested for crime, and have either been sentenced to the House of Refuge, in lieu of a sentence to jail or state prison, or have been sent to these institutions without sentence, in the hope of their reformation. They are supported, directly or indirectly from the public treasury, (the New York house receives an appropriation of $40 for each child from the state treasury, from $15,000 to $20,000 from the city treasury, and a large sum from theatrical licenses). In most, or all of them, the children are employed in some branch of manufacture, or some mechanic art, for from five to eight hours per day, and receive from three to five hours' instruction in school. In all there is more or less religious and moral instruction imparted, having in view their permanent reformation from evil habits and practices. In all, or nearly all, they are confined at night in cell-like dormitories, into which they are securely locked, and their labor, during the day, is under strict supervision, and is generally farmed out to contractors. High walls and a strict police are mainly relied on to prevent escape, and the attempt to do so, or any act of insubordination, is usually punished with considerable though not perhaps unmerited severity. The managers generally possess and exercise the power of indenturing those children who, after a longer or shorter stay, seem to be reformed, even though the period of their sentence has not been completed. A considerable number who have been sent to the House of Refuge on complaint of their parents, are, after a time, delivered to them on application; but a large proportion of these do not do well. Of the others, it is believed that from fifty to seventy-five per cent. reform, at least so far as to become quiet and law-abiding citizens. Of those who do not reform, some, after discharge at the end of their term, are soon recommitted; others are sent to sea, and perhaps amid the hardships of a sailor's life become reformed; others return to the vicious associations from which they were originally taken, and after a few months or years of crime, find their place among the inmates of the county or convict prisons, meet a violent death, or fill a drunkard's grave.

These institutions necessarily combine too much of the character of a prison with that of the school, and while their main object is the reformation rather than the punishment of the young offender, they retain so many penal features that they are objects of dread and dislike to many parents and guardians whose children or wards would be materially benefited by their discipline.

This feature of their management has led to the establishment of another class of reformatories which, though sometimes assuming similar names, are essentially different both in the character of their inmates and in the methods adopted for their reformation. These methods are indeed quite diverse in the institutions coming under this general head, and are to some extent the reflection of the differing views of those who have charge of them.

The subjects taken in charge by these reformatories are somewhat younger on the average than those of the houses of refuge; they are for the most part only guilty of vagrancy and the vicious habits of a street life, or at the worst, of petty pilferings and thefts; they have not been, in most instances, tried for any crime against the laws, or if they have, their tender age has justified the magistrate in withholding a sentence.

When admitted to the reformatory, which is usually done on a magistrate's warrant, they undergo a thorough ablution, and are clothed in plain, neat garments having no distinguishing mark, are well fed, and carefully taught and watched over, and the utmost pains are taken to eradicate their evil habits, and to make them feel that their teachers and those who have them in charge are their best friends and seek their good. Their past history is never alluded to, and is generally known only to the superintendent. In these establishments there are no dormitory cells, and severe punishment is seldom found necessary. The labor of the pupils is seldom regarded as a matter of much importance, though in some instances three, four, or five hours a day are spent in some light employment. From these institutions escapes are unfrequent, and in most cases the children form a strong attachment for their teachers. In some instances they are broken up into groups or families of twenty or thirty persons, each having its "house father" and mother, and its "elder brother," if the pupils are boys, and its matron or "mother," and eldest sister or aunt, if they are girls. These officers teach them and perform the duties indicated by their titles in such a way as to supply, as far as possible, the place of those natural relations of whose judicious influence they are deprived. One of these reformatories is a ship, and the pupils are taught all the duties required of an able-bodied seaman, and the order and discipline are similar to those of the naval school ships. They are taught, in addition to ordinary common-school studies, navigation, and after a few months' instruction are in demand for the mercantile marine, where they not unfrequently are rapidly promoted.

In most of these institutions the pupils remain in the reformatory a shorter average period than those who are inmates of the houses of refuge. In the New York Juvenile Asylum, one of the most successful of these reformatories, they are usually indentured or discharged in six to twelve months. These institutions are usually supported by the large cities, though in a few instances they are State institutions. The labor of the children being of but little account, the expense per head per annum is somewhat greater than in the houses of refuge, but the number of reformations is also greater, and may with considerable certainty be estimated at from seventy to eighty per cent. Among these institutions we may name the "New York Juvenile Asylum," the "State Industrial School for Girls" at Lancaster, Mass., the "Massachusetts School Ship," the "Asylum and Farm School" at Thompson's Island, Boston, the "State Reform School" at Cape Elizabeth, Maine, the "Reform School" at Chicago, the "Catholic Protectories" at West Farms, N. Y., the "State Reform School" at Waukesha, Wisconsin, the "State Reform School" at Des Moines, Iowa, and the "State Reform Farm" at Lancaster, Ohio. In the last, which is the earliest attempt at the introduction of the family or group system for boys in this country, fruit culture is a leading employment of the inmates, and the term of detention is longer than at most of the others.

In our large cities there is still another class of children for whom special preventive agencies are necessary; they are not criminal, they have not generally acquired vicious habits, but they are *every way endangered.* They are often orphans or half orphans, and frequently homeless; many of them are children of foreign parents of the lower classes, and have had no opportunities of education; some are the offspring of vicious or intemperate parents. The greater part of them obtain a precarious livelihood by begging, sweeping crossings, boot-blacking, selling newspapers, statuettes, fruit, or small wares, or organ-grinding. They are all exposed to strong temptations to evil, and have acquired a kind of defiant independence from being driven so early to take care of themselves.

For these children it has been felt that some provision must be made to prevent them from falling into vicious and criminal courses, and to give them the opportunity of becoming good and intelligent citizens. It is from the ranks of these and the two preceding classes that most of our criminals come, and the frequency of burglaries, highway robberies, and crimes against the person, committed by boys and youths from 16 to 21 years of age, shows the necessity of continuing a guardianship over children who are under vicious influences, to as late an age as possible. The best method of accomplishing this desired end has often been discussed, and various plans have been tried with partial success. One organization, (the Children's Aid Society,) with its congeners in other cities, has taken the ground that these children could be saved and permanently reformed by gathering them up, and without any special training or attempts at reforming them, sending them to the West and placing them in good families in the country. With a part of these children, those most amenable to good influences, this plan has proved beneficial, but the very large class of reckless and morally depraved children, all whose associations had been impure and vicious, have become leaders in iniquity wherever they have gone. It should be said, in justice to the Children's Aid Society, that this deportation of children to the West has been but one department of its work; that it maintains, also, numerous industrial schools, has its boys' and girls' lodging houses, its Newsboys' Lodging House, and in many ways seeks to promote the reform and intellectual and moral culture of these morally endangered children. Other institutions have their schools, homes, and missions for these children, where they give them a good common school education and moral training, teach them the rudiments of music, employ them in some of the simpler trades, and try to rouse their ambition to become worthy and intelligent men and women. Of this class of reformatories, acting wholly voluntarily and not sustained by States or cities as such, are the Five Points Mission, and Five Points House of Industry, The Little Wanderers' Home, in New York, The Children's Aid Society and the Industrial Schools of Brooklyn, and similar institutions in all our large and some of our smaller cities. Many of these children are adopted or otherwise placed in families in the country, though not usually at a great distance from the city. Many of the boys go into manufactories or learn a trade, and employment is also found for the girls in manufactories, binderies, &c. But even with these helps to an honest and virtuous life, there is the evil influence of vicious associates, and the physically and morally degrading surroundings of life in the crowded tenement houses, to undo the good which has been done in their instruction and training.

The Homes for the Friendless, Houses of Shelter, Homes for Friendless Girls, Female Christian Homes, Houses of Mercy, &c., &c., form still another class of institutions which give shelter, protection and instruction to young children and friendless girls, who would be the prey of the destroyer but for their care. The work of these institutions is wholly beneficent, and though they may not save all from the paths of vice, yet they accomplish, perhaps, a larger per centage of good than any of the others. Still another class of reformatory institutions, in which, however, the education is almost exclusively moral and industrial, are those for fallen women and those who have been exposed to terrible temptations; the Magdalen Asylums, Houses of the Good Shepherd, St. Banabas Houses, Midnight Missions, Female Homes of Prison Associations, &c., &c. Of late years, these institutions have received a new impulse, and under the control and superintendence of philanthropic and able Christian women, they are meeting with great success in the reformation of these wanderers from virtue. There are also now associations having for their object the reformation and restoration to an honest and upright life of discharged convicts, in most of our large cities; and they also look after those who, through ignorance, sudden temptation, or the malice of others, have been arrested and committed to our prisons and houses of detention.

The number of Houses of Refuge (our first class) is 17, the cost of their buildings and grounds is somewhat more than $2,500,000, and the annual cost of their maintenance about $700,000. Of the Juvenile Asylums and Reform Schools of the milder grade there are fourteen, the cost of their buildings and grounds about $1,700,000, and the annual expenditure about $450,000. The average annual earnings of the inmates of the two classes of reformatories is about $260,000. The number of children in both is somewhat more than 9,000.

Of the institutions of the third class, it is impossible to give any approximately full statistics. They are not under State or municipal control, and though very numerous, and representing a very large amount of investment and annual expenditure, they are entirely the offspring of private beneficence. In the city of New York alone there are nearly forty of them, and a proportionate number in other large cities. The institutions of the fourth class, in which the reformatory element dominates the educational, are also very numerous, and wholly sustained and endowed by private charity. That the aggregate investment, as well as the annual expenditure, of these two classes of institutions exceeds many times that of the public institutions of the first two classes is obvious, and some of our most careful statisticians have placed the investments at more than twenty millions of dollars, and the annual expenditure in the neighborhood of five millions. These are at best mere guesses, but from what we know of the institutions, are probably not beyond the truth. No institutions of the country reflect more credit on the national advancement and civilization than those which have for their purpose the rescue and reformation of imperiled and vicious children and youth.

[The whole subject of Preventive, Correctional and Reformatory Institutions and Agencies, as developed in France, Germany, and Great Britain, with special reference to the immediate recognition of the family principle in the organization and administration of similar institutions and agencies in this country, was treated quite exhaustively in the third volume of Barnard's *American Journal of Education*, in 1857, and the several articles were issued in a Supplementary Number, and in a separate volume entitled *Reformatory Education*, and distributed widely among city and state officials charged, directly or indirectly, with the administration or consideration of the problem of juvenile exposure, delinquency and crime. While Commissioner of Education, Dr. Barnard issued a circular to gather the material for a comprehensive survey of this department of educational institutions in different States and countries, and at the same time published a very valuable paper by Dr. Wichern, on the Reformatory Institutions of Germany, which have sprung up mainly on the model of the Rough House at Horn, of which he was the founder. He did not continue in office long enough to receive returns from his circular, but he will avail himself of recent publications and personal observation to issue a new edition of the volume above referred to.]

## V. SUPPLEMENTARY INSTRUCTION.

### INTRODUCTION.

Besides the formal instruction given in institutions expressly established for Elementary, Secondary, Collegiate, Professional and Special Education, there are other institutions and agencies which can act on the individual in almost every stage of his intellectual development, and do act with the greatest effect, in a majority of instances, after the individual has passed beyond the control of regular schools of every kind. These institutions and agencies in various ways influence the national taste, attainments and character, and may be considered together under the head of Supplementary Education. We select the two, as the most potential in our modern American civilization outside of the formal school—the Printed Page and the Living Voice—the Book and the Lecture—the Library and the Lyceum, to which should be added or associated, Occupation.

(1.) *The Book.*

The finest minds have exhausted their powers of language in trying to express in words the value of Books. To Cicero, the orator and statesman, the volumes which composed his private library "seemed to add a soul to his dwelling;" to Bacon, the philosopher and man of affairs, "Libraries are as shrines where all the relics of ancient saints, full of true virtue, and that without delusion and imposture, are preserved;" to Milton, the poet, and fervid apostle of religious and civil liberty, "A good book is the precious life-blood of a master spirit, embalmed and treasured up on purpose to a life beyond life;" "God be thanked for books," says the clear, pure, and eloquent Channing, in his address to young men and working men, which has found an echo in millions of hearts and homes—"they are the voices of the distant and the dead, and make us the heirs of the spiritual life of past ages. They are the true levelers. They give to all who will faithfully use them the society of the best and greatest of our race. No matter how poor I am—no matter though the prosperous and the fashionable will not enter my obscure dwelling—if the Sacred Writers will enter and take up their abode under my roof, if Milton will cross my threshhold to sing to me of Paradise, and Shakspeare to open to me worlds of imagination, and Franklin to enrich me with his practical wisdom, I shall not pine for want of intellectual companionship."

(2.) *The Living Voice.*

But as a teacher, for rousing the dormant faculties, and fixing and adjusting the attention, particularly of adults, the living voice is far more efficient; and when associated with books used in class or in solitary study, and combined with observation of nature, or the actual processes of business in hand—the living voice can suggest the motive, the means, and the methods to supplement, rapidly and pleasantly, all deficiencies of school instruction.

(3.) *Occupation.*

No formal institution of instruction, no agency employed in the class or lecture-room, no book however rich in individual or accumulated wisdom, can compare in the work of self-education with the processes of the daily occupation of an individual, thoughtfully pursued in the field, the household, and the workshop. This is the school of New England handiness and inventions.

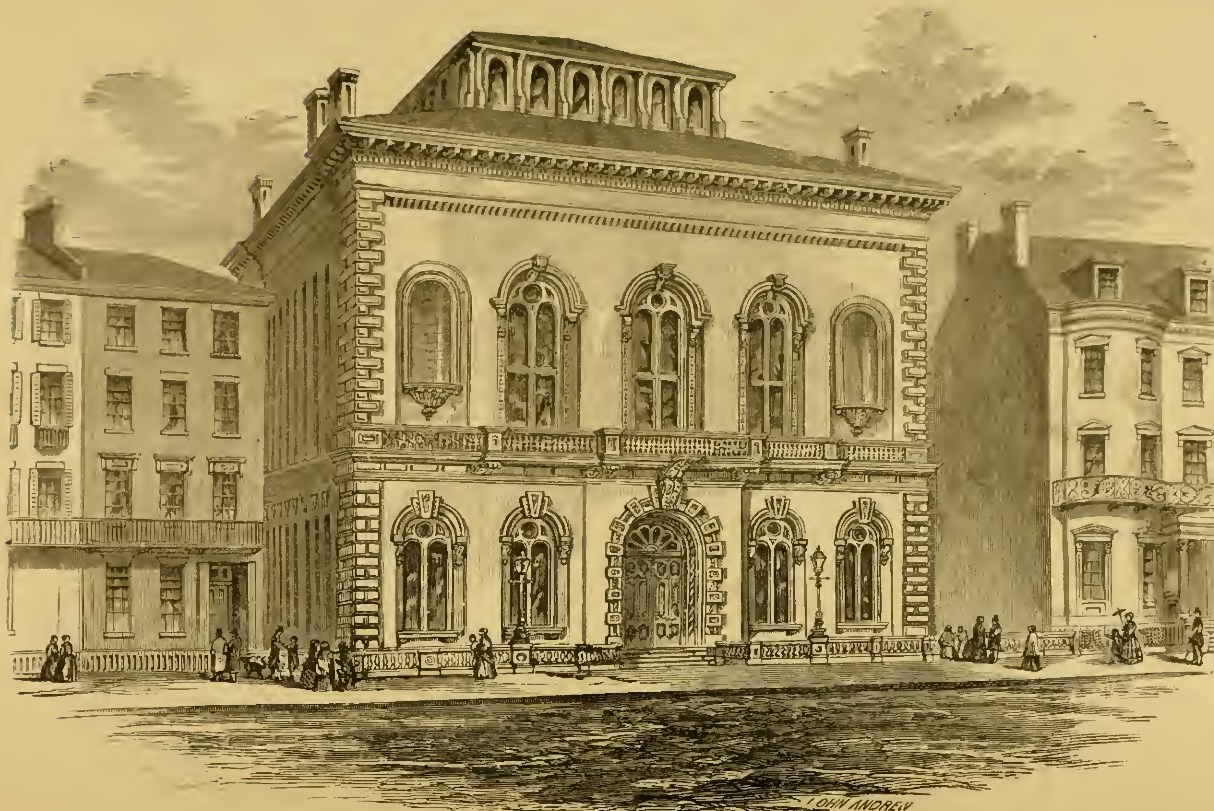
### I. LIBRARIES.

At the close of the Revolution there were very few collections of books, either public or private, in this country. With the exception of political works, and these mostly pamphlets, a very few text-books and hymn books, one or two editions of the Bible printed from type (stereotype plates were unknown till much later), and perhaps a dozen religious treatises, the books in the country were all imported from Europe, and generally from England, either in small quantities by the booksellers or in single copies by individuals. The Revolutionary War, though in the end favorable to education and intelligence, at first was a serious hindrance to both; for with the political disenthrallment of the country from the British yoke, there sprang up a strong desire to be free from it also in all matters of trade, of literature, and of education; and as there were very few publishers who possessed the requisite capital and daring to publish books in considerable numbers, for which, indeed, in the impoverished condition of the country, there would have been but little demand. A few of the twelve or thirteen colleges had small libraries. Of these the largest was that of Harvard University, which, though destroyed by fire in

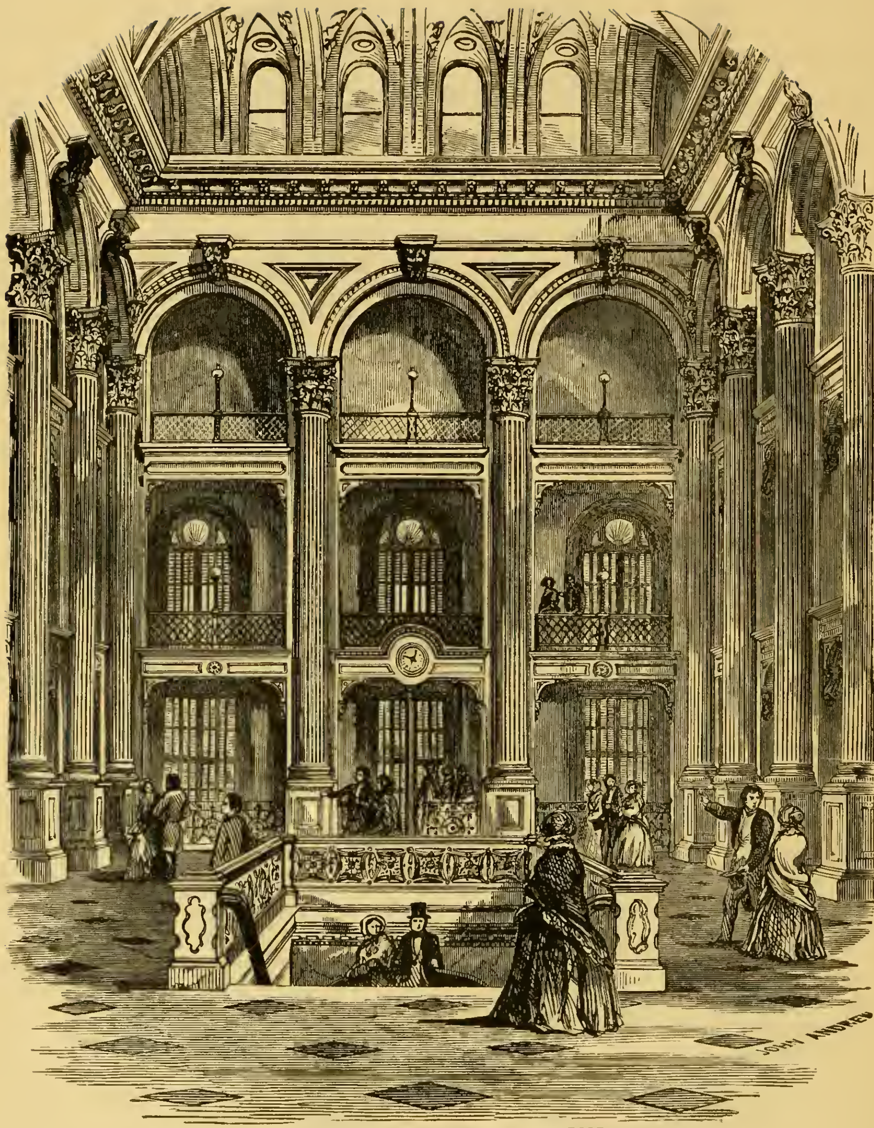
1764, had by great exertions brought up to about 10,000 volumes in 1783; Yale, Princeton, William and Mary, the Univerity of Pennsylvania, and Kings (now Columbia) College had each small collections, though containing some valuable books; but none of them much exceeded, after the vicissitudes of the war 2,000 volumes, and the library of William and Mary had, probably, not more than 1,200 or 1,400. Brown University, Dartmouth, and Rutgers had made small beginnings. There were six or seven small proprietary libraries, the largest being the Philadelphia Library Company and Loganian Collection, founded by Franklin in 1731, and having in 1783 about 5,000 volumes; the New York Society Library at the beginning of the war contained 7,000 or 8,000 volumes, but the British soldiers carried off its books by the knapsackful and bartered them for grog. In 1795 it had only 5,000 volumes, though considerable additions were made to it after the war. The Redwood Library, at Newport, R. I., was not large, but had a considerable number of very choice and valuable books. The Charleston Society Library had been one of the largest in the country, but was almost entirely destroyed by fire in 1778. The Providence, Salem, and Portland Atheneums, founded respectively in 1753, 1760, and 1765, had small collections but well selected. Beside these there was the special library of the American Philosophical Society at Philadelphia, and a State Library of a few hundred volumes at Concord, New Hampshire. This was, we believe, a complete list of all the public libraries of any importance at the close of the Revolutionary War. Nor was the period from the close of the war to 1800 favorable to any considerable growth of either libraries or literary institutions; for libraries being among the outgrowths of an opulent and luxurious civilization, we could hardly look for their increase amid the poverty and financial revulsions which continued till near the close of the last century. The eleven colleges, elsewhere enumerated, which were founded between 1781 and 1800 have now respectable and some of them very considerable libraries, but they are all, or mainly, the growth of the period since 1820. Of other libraries, there are only three, and those of inferior grade, which were founded during this period (1781–1800). These are the Boston Library Association, founded in 1794, and which now at the end of nearly 80 years has about 20,000 volumes; the Byberry Library of Philadelphia, founded the same year, and one in Dublin, New Hampshire, in 1793, each of which now numbers 2,000 volumes.

Between 1800 and 1818 there were eleven Colleges and seven Theological Seminaries founded, most of which have now good, and some of them large libraries. To this period belong also the beginnings of the Boston Atheneum, now the fifth or sixth library in the country in the number of its volumes; the first library of Congress, destroyed by the British in 1814, the large collection of the New York Historical Society, and the Ohio State Library at Columbus, the commencement of the special libraries of the American Antiquarian Society at Worcester, and the American Academy of Natural Sciences at Philadelphia, and ten or twelve smaller public libraries, mostly State, which were originally established at the capitals for the accommodation of the courts and legislators.

Since 1818, a period of fifty-four or fifty-five years, about 340 collegiate institutions, more than 130 schools of superior instruction for girls, fifty-six agricultural and scientific schools, more than one hundred theological institutions, 40 law schools, and about 90 medical and pharmaceutical schools, have been established, and nearly all these have libraries of greater or less extent, forming a grand aggregate of over 2,500,000 volumes; more than thirty State libraries have been founded with about 400,000 volumes—the largest being those of New York at Albany, with 90,000 volumes; Michigan, with about 42,000; Ohio, about 40,000; Massachusetts, with 37,000; Maine, with 33,000, and Virginia with about 30,000. Within this period, too, the great free libraries of the country have all been established; the Library of Congress in place of that destroyed by the British, and now numbering 246,000 volumes and 45,000 pamphlets; the Astor, with about 170,000 volumes; the Boston City Library, with 183,000 volumes; the Loganian and Philadelphia Library Company, which though previously founded, has had its principal growth since 1818, and under the recent bequest of Dr. James Rush is likely to become one of the largest libraries in the country, numbering as it now does 100,000 volumes; the New Lenox Library of New




BOSTON CITY LIBRARY. EXTERIOR.




BOSTON CITY LIBRARY. INTERIOR.

York, so grandly endowed, and having as a nucleus Mr. Lenox's own extensive and invaluable collections; the Watkinson Public Library of Reference at Hartford, with about 30,000 volumes, and some sixty or seventy other free libraries in the Northern and Eastern States, ranging from 5,000 to 28,000 volumes each. The law regulating the establishment and management of free town libraries in Massachusetts has greatly encouraged their growth, and most of the cities and many of the large towns of that State have now good, though not generally very large public libraries sustained by the towns. A few brief notes respecting some of the largest of these libraries may be interesting.

The Library of Congress has grown very rapidly within a few years past, the Peter Force Collection of American History, the Smithsonian Library being included with it, and since 1869 the issue of copyrights being vested in its chief librarian, which secures to it two copies of every book copyrighted in the United States. In its 246,000 volumes there are at least 30,000 duplicates, but it is very rich in the transactions of foreign learned societies, in American local and general history, and indeed in history generally; and has probably the best collection of works in every department of political science to be found in this country. It is a lending library only to members of Congress and government officials, but is free for reference and consultation to all others.

The Astor Library was founded by a bequest of $400,000 by John Jacob Astor, in 1844, but was not opened till 1854, when it had about 80,000 books upon its shelves. Mr. William B. Astor, son of the founder, has erected a second building for its extension, as well as expended freely in the purchase of books, to the aggregate amount of $200,000. Its present number of volumes is about 170,000. It is not a lending library, but is open for consultation, with all conveniences provided, for six or eight hours each day. The Philadelphia Library and Loganian Collection is one of our oldest libraries, but has grown rapidly within a few years past, and is now so largely endowed as to be able to take rank with the largest in the country, within a few years. The Boston City Library, now ranking next to the library of Congress among the free libraries, has had a wonderfully rapid growth since its foundation in 1848. Joshua Bates, a native of Boston, but long resident in London, has more right than any other man to be considered its founder, as his original gift of $50,000 and several thousand volumes of books, prompted the liberality of individuals, as well as the city authorities, who have done their part nobly in fostering and providing for its extension. Of its other benefactors we may name Jonathan Phillips, Josiah Quincy, Jr., J. P. Bigelow, Edward Everett, Robert C. Winthrop, George Ticknor, Theodore Parker, and others. It has now nearly 190,000 volumes. It is in part a lending library, and the first great free library in the world which has carried the lending system to such an extent. It has, of course, its specialties, but the trustees endeavor to make it complete as possible in all departments.

The Lenox Library, the buildings for which are now (1873) erecting in New York, will be, unquestionably, one of the most valuable of American libraries. Its founder, with scholarly tastes and abundant means, has long been engaged in collecting a private library containing the rarest and most valuable literary treasures which money could purchase. In its collection of Bibles, missals, block-books, and indeed *incunabula* generally, it has no superior on this continent, and not more than one or two in Europe. This choice and valuable collection is to form the nucleus of the grand library for which he is now preparing a home, and in which his ample endowment will soon gather an accumulation of literary wealth which will make it a library worthy of the great American metropolis.

There is another class of libraries, usually free for consultation, some of which have attained, within the past thirty years, to considerable magnitude, viz., those of the historical societies. Of these, the largest are: the Wisconsin State Historical Society's Library, at Madison, of 50,500 volumes; the New York Historical Society's Library, with 31,000 volumes; the Long Island Historical Society's, in Brooklyn, which in ten years has accumulated nearly 26,000 volumes; the Massachusetts Historical Society's, with nearly 19,000 volumes; the Connecticut Historical Society's, with about 25,000, including Dr. Thomas Robbins' valuable collection in ecclesiastical and New England history; the Maryland Historical Society's, with 17,000 volumes; the Minnesota Society, with 13,500 volumes; the American

Antiquarian Society, at Worcester, about 52,000 volumes; and the New England Historical and Genealogical Society, of Boston, about 12,000. There are two or three others, with less than 10,000 volumes each. Several of the Scientific Societies and Institutes have special libraries of great value and considerable magnitude, the largest being those of the Academy of Natural Sciences, Philadelphia, 23,500; the American Philosophical Society, also of Philadelphia, 18,000; the Natural History Society, of Boston, 13,000; and the American Institute, New York, 10,500.

The late George Peabody, among his other benefactions, provided for three or four considerable libraries; that of the Peabody Institute, at Baltimore, having already 43,000 volumes; the Peabody Institute, at Danvers, Mass., about 20,000 volumes; the Institute at Peabody, 14,300 volumes; and another at Georgetown, D. C. Other men of public spirit have endowed similar libraries in various parts of the country, as, David Watkinson, at Hartford, Conn., Silas Bronson, at Waterbury, Conn., Ezra Cornell, at Ithaca, N. Y., and Peter Cooper, in connection with the Cooper Union, at New York.

We come next to the class of Proprietary and so-called Mercantile Libraries, all lending libraries, and requiring, in addition to a greater or less endowment, an annual or life subscription from all who would participate in the use of the library, lectures or classes. Some of these have attained to the highest rank among our great libraries, as, for instance, the Mercantile Library, of New York, which has over 154,000 volumes; the Boston Athenæum, which has 108,000; the Mercantile Library, of Philadelphia, 59,000; the Mercantile Library, of Brooklyn, which has 45,000; the Mercantile Library, of Cincinnati, which has 42,000; that of St. Louis, with 34,000; the Providence Athenæum, with 32,000, the New York Society Library with the same number, and Mercantile Libraries and Young Men's Institutes in San Francisco, Baltimore, Hartford, Conn., Boston, Detroit, Pittsburgh, Cleveland, and other cities, with libraries ranging from 20,000 to 30,000 volumes each.

The Young Men's Christian Associations have in many cases founded libraries which, though seldom large, yet supply, to some extent, the demand for books of their members. The Association in Washington, D. C., has, we believe, the largest of these libraries, numbering about 13,000 volumes; the others are all under 10,000 volumes, though several approximate that number. The aggregate number of volumes in these libraries exceeds 150,000.

In several of the Northern and Western States there are libraries of greater or less extent connected with the public schools; not always wisely selected, and in some cases not much used, but in the aggregate forming a vast number of books. The latest school returns indicate that there are more than 5,000,000 volumes in their libraries.

We have thus passed in review the principal public libraries of the country. There are according to the latest returns: one library of about 250,000 volumes; three of over 170,000; one of over 150,000; two of over 100,000; two of over 90,000; five of over 50,000; seven of over 40,000; twenty-one of over 30,000; fifty of over 20,000; one hundred and thirty of over 10,000; and two hundred and seventeen of 5,000 and over. The total aggregate of volumes in college, State, national, proprietary, subscription, free, town, and school libraries is very nearly twelve millions volumes, and is increasing with great rapidity.

There is still another class of libraries, containing, in their totality, a vast number of volumes, and in many cases of considerable size and value, viz., the Sunday School libraries. Few of these contain less than 200 volumes, and many of them have upwards of 1,000. More than 6,000 different works have been published for these libraries within the last twenty-five years, by the publishing societies and private publishers, and large drafts are also made by the larger schools on English publications, and those intended for adults. Estimating the number of these schools at 56,000, or about two-thirds the number of churches, and the volumes in each library at 200, we have more than 11,000,000 volumes collected in these humble libraries.

As might have been expected, the rapid growth of public libraries has stimulated gentlemen of wealth and intellectual tastes to collect private libraries of considerable extent, and in many cases devoted to some specialty. In many cases these collections, on the death of their owners, or sometimes during their lives, come into the possession of some great public library, adding greatly to its value in certain directions. Thus the magnificent private library of James Lenox, to which we have already alluded, is to form the nucleus of the Lenox Library; the fine collection of works on the fine arts, of Rev. Dr. Magoon, has become the property of Vassar College, and the life-long accumulations of the late Peter Force, in American general and local history, have been incorporated into the Library of Congress, and so of the collections of Spanish literature of Mr. Ticknor. There are said to be, in the city of New York alone, fifty private libraries, containing 10,000 volumes or more each, and in Boston quite as many. Philadelphia has also a large number, while Cincinnati, St. Louis, and San Francisco, have each their fair share. So, too, had Chicago before the great fire destroyed the accumulations of books which her wealthy citizens had made in many years of liberal expenditure. Brooklyn has for some years past been noted for its valuable private collections, and those of Henry C. Murphy, J. Carson Brevoort, T. W. Field, A. J. Spooner and others, in local and general history and geography, of Rev. Dr. Storrs, and Rev. H. W. Beecher in Christology and general English literature, and of several other gentlemen in illustrated and costly productions, are specially noteworthy. Of other remarkable collections of works illustrating American history, the most valuable are those of George Brinley of Hartford, George W. Greene of Providence, George Bancroft, W. J. Davis, William Menzies, and J. R. Brodhead of New York, J. L. Motley and Robert C. Winthrop of Boston. The library of Hon. Henry Barnard, of Hartford, Conn., is more complete on the subject of education than any other in the country; that of Rev. Barnas Sears, at Staunton, Virginia, is very full on some departments of the same subject; that of S. Austin Allibone, of Philadelphia, is remarkable for its collections on English biography, literature and criticism; that of W. Parker Foulke, of the same city, on prisons and prison discipline; that of C. L. Bushnell on numismatics; that of J. A. Stevens, Jr., on the literature of the Middle Ages; those of Messrs. W. P. Chapman, R. G. White, and J. W. Wallack, on dramatic and especially Shakspearean literature; that of D. W. Fiske, on Scandinavian literature; that of Rev. W. R. Williams, on Welch Literature and Ecclesiastical History; that of R. M. Hunt, on architecture; those of Rev. Dr. Forbes, Rev. Dr. H. B. Smith, Rev. Dr. E. F. Hatfield, Rev. Dr. S. H. Tyng, and Rev. Dr. Morgan Dix, on theology, ecclesiastical biography, and patristic literature.

There are, in connection with many of our benevolent and humane institutions, special libraries containing 100 to 1,000 volumes each, devoted to the particular work of those institutions. Some of these we have already enumerated. Among the most noteworthy of the others are the collections of works on Deaf Mute instruction in the American Asylum for the Deaf and Dumb at Hartford, and the New York Institution for the Deaf and Dumb; the collection of Bibles in all languages and of all dates, of the American Bible Society; the early versions, codices and fac similes, and the extensive collections of works on biblical criticism and exegesis, procured by the American Bible Union for the use of its translators; the library of the American Congregational Union in Boston, remarkable for its religious periodical literature; that of the American Board of Commissioners for Foreign Missions, containing not only a vast amount of missionary literature, but nearly a complete set of all the publications issued by its missionaries; that of the New York Geographical Society, very full on geographical topics; that of the Lyceum of Natural History, of New York, now deposited with the Mercantile Library of that city, and remarkable for its collections of the transactions of Foreign societies; and that of the National Prison Association, which, though recently established, has a very complete collection of both American and Foreign Works on Prisons, Punishment and Prison Discipline. The following table gives a list of the principal libraries of the country, with the date of their organization and the number of volumes, as near as can be ascertained, at the close of the year 1872.

### II. THE LYCEUM AND OTHER LECTURE INSTITUTIONS.

The origination of the lyceum as a means of mutual instruction in this country is due, in the first instance, to Benjamin Franklin. His "club for mutual improvement" was founded in Philadelphia in 1727, and after forty years' existence became the basis of the American Philosophical Society. There probably were other societies for mutual improvement organized in different towns and cities of the country, during the hundred years that followed the organization of Franklin's club; but there are no records of any such in the possession of the public, previous to 1824, when Timothy Claxton, an English mechanic, succeeded in founding one, or rather in modifying a reading society, which had been in existence for five years, into what was really a lyceum, in the village of Methuen, Mass. Its exercises were weekly, and in the following order: the first week, reading by all the members; the second week, reading by one member selected for the purpose; the third week, an original lecture; the fourth week, discussion. In 1826, Mr. Josiah Holbrook, then of Derby, Conn., communicated to the *American Journal of Education*, then conducted by Mr. William Russell, his views on the subject of "*Associations of Adults for the Purpose of Mutual Education*," in which were contained the germs of the plan of the *Lyceum*, as subsequently developed by him in his lectures and publications. From the first, his views were of wider scope than the organization of a mere local association; they comprehended the establishment of such associations in every town and village, and their union, by representation, in county, state, and national organizations. They contemplated also, not only mutual instruction in the sciences, but the establishment of institutions for the education of youth in science, art, and morals; the collection of libraries, and of cabinets of minerals and other articles of natural or artificial production, to be increased and enlarged by mutual exchanges, by the different associations. Lectures and practical agricultural occupation, the results of which, it was supposed, would materially diminish the cost of instruction, also formed a part of his programme.

The first association formed in accordance with this plan was organized at Millbury, Mass., by Mr. Holbrook himself, in November of the same year, and was called "Millbury Lyceum, No. 1, Branch of the American Lyceum." Other towns soon after organized lyceums, and these were combined a few months later into the Worcester County Lyceum. Not long after, the Windham County, Conn., Lyceum, with its constituent town lyceums, was established; Rev. Samuel J. May, then of Brooklyn, Conn., rendering valuable assistance in the work.

From this time onward to his death in 1854, Mr. Holbrook devoted his whole energies in one way and another to the promotion of these institutions, and to such measures in connection with the cause of education as should promote mutual instruction in children as well as adults. By scientific tracts, by newspapers and other publications, by the manufacture of school apparatus, and by the collection of small cabinets of minerals, to serve as *nuclei* for larger cabinets, by scholars' fairs, by lectures, and long journeys, and by appeals to the members of Congress and of the State Legislatures, he succeeded in rousing a powerful and continued interest in the subject of mutual instruction, which, if it did not accomplish all his own plans, at least gave a wonderful impulse to the general intellectural culture of the nation. The lyceums he founded have passed away, at least in their original form, but in their places, and in a great measure as an indirect result of his agitation, we have in every considerable town or village Debating Societies, Young Men's Institutes, Mechanics' Institutes, Library Associations, Young Men's Christian Associations—the four latter often with circulating libraries, courses of lectures, and classes for instruction in science, art, and languages, and in many cases with schools and classes attached. We have also lecture foundations, either connected with our colleges or professional schools, or independent, in which courses of instruction in physical science, history, literature, or language, are communicated to popular audiences.

In rendering the scientific lecture a popular institution, our country is greatly indebted to the late John Griscom, LL.D., Prof. B. Silliman, Sr., Rev. Henry Wilbur, and Truman W. Coe, Esq. Dr. Griscom delivered his first course of popular lectures on chemistry in New York city in the winter of 1808; they were largely attended, and were continued for a series of years. Prof. Silliman commenced popular lecturing on the same subject in New Haven about the same time, in connection with his professional courses. He subsequently delivered popular courses of lectures on chemistry and on geology in many of the large cities of the country. Within the last thirty or thirty-five years the late President Hitchcock of Amherst College, the late Prof. Shepard, Prof. Dana of Yale College, the brothers Rogers, now both dead, Prof. Henry, and other eminent geologists, have given courses on geology to popular audiences; Prof. Guyot and others have lectured on physical geography; the late Horace

Mann, Charles Brooks, David P. Page, Henry Barnard, John D. Philbrick, S. B. Woolworth, T. H. Burrows, E. A. Sheldon, and a score of others on educational topics; Hon. George P. Marsh, Profs. W. D. Whitney, S. S. Haldeman, and others, on language; Profs. Doremus, Draper, Silliman, Jr., Cooke, Richards, and others, on chemistry; Profs. Agassiz, Morse, Dana, and others, on palæontology and natural history; the late General and Prof. Mitchel, Youmans, Eaton, Morse, Loomis, G. F. Barker, Young, Sir Charles Lyell, and Professor Tyndall, on astronomy, spectroscopy, and light; Messrs. Bayard Taylor, Kane, Hays, Hall, Du Chailln, Powell, and others, on their explorations; the late Prof. Lieber, Baird, Walker, Wells, Perry, and others, on political philosophy and financial topics, and other eminent scholars on other subjects.

The Lowell Lectures at Boston, founded by the munificence of the Hon. John Lowell, gives annually several free courses of lectures to large audiences on the most important branches of moral, intellectual, and physical science, and from the liberality of its compensation to the lecturers, induces elaborate and conscientious preparation on their part; and the benefit of this preparation inures also to other audiences, to which these lectures are repeated. The Graham Institute in Brooklyn, N. Y., has a similar though less opulent foundation, and its courses of lectures have been remarkable for their ability and adaptation to a popular audience. Other foundations have been established for lecture courses in other cities, but for the most part in connection with colleges or theological seminaries.

The noble Peter Cooper foundation, in New York city, is very broad, covering a very large reading room, supplied with all the best foreign and American newspapers, literary, scientific, and technological periodicals, a considerable and very valuable library, evening schools in mathematics, mechanics, languages, &c., schools of design and mechanical drawing, wood engraving, painting, architecture and sculpture, and courses of lectures on practical science.

The late George Peabody, among his other good works in the cause of education, endowed an institute in Baltimore with a fund of over a million dollars, to include a library, courses of lectures on science, art, and literature, prizes for scholarship in the high schools, an Academy of Music, and a Gallery of Art. He also provided for an Institute of Archæology at Cambridge, with an endowment of $150,000, a Museum of Natural History at Salem with the same amount, and a Department of Physical Science at Yale College with a similar sum.

Harvard University has also established, within two or three years past, courses of lectures of the very highest grade, open to all upon the payment of the fees, in which scholars of the first rank have discussed, at their leisure, topics usually considered above the ready comprehension of any but the well educated class. These lectures were not largely attended.

For some years there seemed to be danger that the courses of lectures given under the superintendence of the Young Men's Institutes and Mercantile Library Associations would become merely the means of amusing rather than instructing the audiences, and so would lose their character of supplementary means of education; but this danger is now evidently passing away; the lectures best attended are those which have the highest scientific character, provided the science is duly popularized. One agency in securing this beneficial result has been the Young Men's Christian Associations, which, by making the standard of their lectures high, have compelled other organizations to do likewise.

Under this head of means of supplementary instruction should perhaps also be included those institutions, all very recently founded, and which do so much honor to their founders, which, while they contemplate mainly systematic instruction, provide to some extent popular courses in the practical arts and technological science. Among these we may name the "Massachusetts Institute of Technology," at Boston; the "Museum of Comparative Zoölogy," at Cambridge; the "Worcester Free Institute;" the "Horticultural School for Women," at Newton Center, Mass.; the "Thayer Engineering School," of Dartmouth College; the "Stevens Institute of Technology," at Hoboken, N. J.; the "School of Mines," of Columbia College, New York; the "Scientific School of Lehigh University," South Bethlehem, Pa.; the "Polytechnic College," of Philadelphia; the Agricultural Department of "Hampton Institute;" some of the practical departments of "Cornell University;" and the "O'Fallen Polytechnic Institute," of St. Louis, Mo.

## VI. SOCIETIES FOR THE ADVANCEMENT OF SCIENCE, EDUCATION, AND LITERATURE.

### INTRODUCTION.

As means of supplementary instruction, and largely in those higher walks of literature and science not generally cultivated, the Scientific and Literary Societies of the country have been of great service. They may be divided into two classes: those of a general character, which, while principally devoted to the promotion of some particular subject, as history, local and general, geographical science and discovery, genealogy and biography, and in some cases natural history, antiquarian researches, prison discipline and statistics, ethnology and philology, yet admit other topics more or less connected with these, and receive as members persons not specially versed in these subjects, their object being to enlist a large clientage in their pursuits, and, by collecting a library and museum, and having courses of lectures, to popularize their labors and increase their resources. A second class are more strictly scientific in their character, admitting members only after careful scrutiny, and on proof of their attainments in the special range of inquiry to which the society or association is devoted. To this class belong the American Academy of Arts and Sciences, the American Academy of Natural Sciences, the Boston Natural History Society, the Essex Natural History Society, the American Oriental Society, the National Academy of Science, and several peripatetic associations holding their annual congresses in different cities and sections of the country, every year. Among these the oldest, and usually the best attended, is the American Association for the Advancement of Science.

Besides these more technically scientific associations, there are societies of more strictly educational and philanthropic aims, both National and State, such as the American Institute of Instruction, and more recently the American Association for the Advancement of Social Science. A National Prison Congress has also held two sessions, and led to the formation of an International Prison Conference, which held its first session in London, in 1872.

#### (1.) *Literary and Scientific Societies.*

The Societies of the first class have been very useful from their exertions in collecting historical and archæological documents, and relics and specimens illustrating the early condition of our country, the habits, customs, and mode of life of the Indian tribes, and often, also, similar particulars in regard to other nations and times. This has been particularly true of the Historical Societies, of which there are now one or more in most of the States, and even in some of the Territories. As we have seen in our account of the libraries of the country, several of these societies have made very large collections of books, not always exclusively historical, but embracing a wide range of literature. Most of them have also museums, more or less extensive, and often including many objects of great interest and value. The earliest of these societies is the Massachusetts Historical Society, founded in 1791, which has published over 50 volumes of Transactions and Collections. The New York Historical Society came next, in 1804, and has a fine library, large archæological collections, and many excellent portraits and historical paintings. It has also published several volumes of historical collections. The American Antiquarian Society, at Worcester, founded in 1812, mainly by the efforts of the late Isaiah Thomas, has a fine library and an archæological collection of great value and interest. The Connecticut Historical Society, established in 1825 at Hartford, and the Georgia Society, at Savannah, founded in 1839, have fine libraries and museums of considerable value, that of Connecticut receiving the library and collection of Rev. Thomas Robbins, D. D., begun fifty years before. The Maryland Historical Society, founded in 1843, the Minnesota Society, at St. Paul, founded in 1849, the Chicago Society, founded in 1856, and the Long Island Society, at Brooklyn, L. I., founded in 1862, are the most efficient of the younger societies. All have good libraries, some of them very large ones, and by courses of lectures, by able papers prepared by their members, and by sub-organizations within their membership, they succeed in enlisting public interest and in popularizing their special objects.

There are not more than two or three distinct Geographical Societies in the country; the oldest and most efficient, the American Geographical Society, of New York, has had a hard struggle with adverse fortunes, but through the devotion of some of its past and present officers, has at last attained to a commanding position. It devotes itself exclusively to its specialty, and has collected an exceedingly valuable library and collection of maps and charts, as well as other articles illustrative of geographical discovery. It has taken an active part in promoting the voyages and journeys of exploration which have been sent out to the Arctic Ocean and elsewhere, and it has done much to promote a more thorough study of geography and more accurate map drawing. There are two or three Genealogical Societies, the membership of which is mainly composed of those who take an interest in genealogical, biographical and historical researches, though not exclusively so, as it is the aim of those who are the founders of these societies to awaken a more general interest in their pursuit.

The Natural History Societies are more numerous. Every considerable city in the country has more or less students of natural history, and these have generally associated themselves either in a Natural History Society, or in a department of natural history connected with a historical society, or literary society.

Of late years, many of our larger and older colleges, as Yale, Harvard, Williams, Amherst, Union, Cornell, Michigan, &c., &c., have their Natural History Societies, the officers of which are often members of the College Faculty, and several send out their delegations either during the vacations, or sometimes in term-time, on exploring expeditions.

The American Philological Society was founded about the year 1860, by Rev. Nathan Brown, D. D., now missionary in Japan, having primarily two objects in view, one the propagation of a phonetic system of writing and printing not liable to the objections which attached to others previously propounded to the public; the other, the approximation to a universal language, or at least the elements of one, which should make it easier and more practicable to multiply copies of the Bible and religious books among all nations. Incidental to this was the accumulation of vocabularies of all languages, which had been either partially or wholly reduced to writing for the purposes of comparison and study, and analyses of the language of savage tribes, to ascertain, as far as practicable, the elements which were common to them; and, also incidentally, the collection of manuscripts, books, leaves, inscriptions, and drawings, by savage or half-civilized nations, as well as specimens of their manufactures, their idols, &c., &c. The Society has accumulated a small library and museum, and is prosecuting its purposes with earnestness. Its membership is open to all, but is practically limited to those who take an interest in its investigations.

These are the most important of the Societies of the first class. Of those of the second class, which lay a more exclusive claim to the title of 'Scientific Societies,' we need say but little, as their names generally give an idea of their purposes and objects. The American Philosophical Society, founded in Philadelphia in 1743, is the oldest of our existing Scientific Societies. The American Academy of Arts and Sciences was founded in Boston in 1780, and has published several volumes of Transactions. The Connecticut Academy of Arts and Sciences was founded at New Haven in 1799, and has made many valuable contributions to science. The American Academy of the Natural Sciences was founded in Philadelphia in 1818, and though meeting with many discouragements in its earlier history, has recently erected a suitable building for its vast collections of fossils, animals and birds, and the Morton collection of skulls, the finest on the American continent. It is in a more prosperous condition, perhaps, than any other of the scientific societies. The Boston Natural History Society has a very fine museum.

The Association of American Geologists, one of the traveling associations, founded in 1840, was in 1845 absorbed in the American Association for the Advancement of Science, which still maintains its annual congresses, with a session usually of two or three weeks. It comprises the greater portion of the scientists of the country, and its papers and essays are often of great merit and permanent value. The National Institute, a scientific society founded in Washington in 1840, after a few years of activity, transferred its collections to the Smithsonian Institution.

The Smithsonian Institution, though a very active organization in the diffusion of knowledge among men, with large resources, can hardly be classed as a scientific society, since it has no membership except its regents and officers. Its books have been transferred to the Library of Congress, and its valuable collections are open to all scientists, and facilities provided for the distribution of its specimens and publications to such colleges, museums, and scientific societies as will make a suitable use of them for promoting its objects. It was chartered in 1846.

The American Oriental Society, at New Haven, founded in 18—, mainly through the efforts of Prof. Salisbury, has, in the few years of its existence, contributed greatly to the promotion of our knowledge of Oriental languages and science.

The National Academy of Science, founded by act of Congress in 1863, and limited to fifty resident associates, is an attempt to blend the French Institute with the peripatetic plan, which, in the American Association and other institutions, had proved so efficient in this country. Its meetings are either annual or semi-annual, and held at different points. Its sessions are from one to two weeks, and its members are divided into working sections. Its meetings are public, and papers on different scientific topics are read by members, and may be contributed, by those not associates, through members. The election of new members to the vacancies made by death are prefaced by a rigid and protracted scrutiny. One of the conditions of its incorporation is the obligation to investigate and report on any scientific subject referred by any department of the government for its consideration.

The American Philological Association was organized in 1869, though preliminary meetings had been held in 1868. It is one of the peripatetic associations, and has for its objects the more perfect mastery of the ancient classical languages and literature, and investigations into the structure and philosophy of the Indo-European and Oriental languages. It has printed three volumes of its annual proceedings.

The latest of these scientific societies is the American Union Academy of Literature, Science, and Art, founded in 1869 in Washington. It embraces within its scope the entire circle of the sciences, and is divided into ten sections or departments, each of which is presided over by a supervising committee of three, through whom all papers in their several departments must be presented, and, if approved, reported to the Academy, and published if the Academy so order. The membership is limited to such as are proficients in some branch of knowledge coming under one of the ten sections, and the ballot, after a favorable report by the committee of that section, must be unanimous or they are not elected. Prof. J. W. Draper, M. D., LL. D., was the first president.

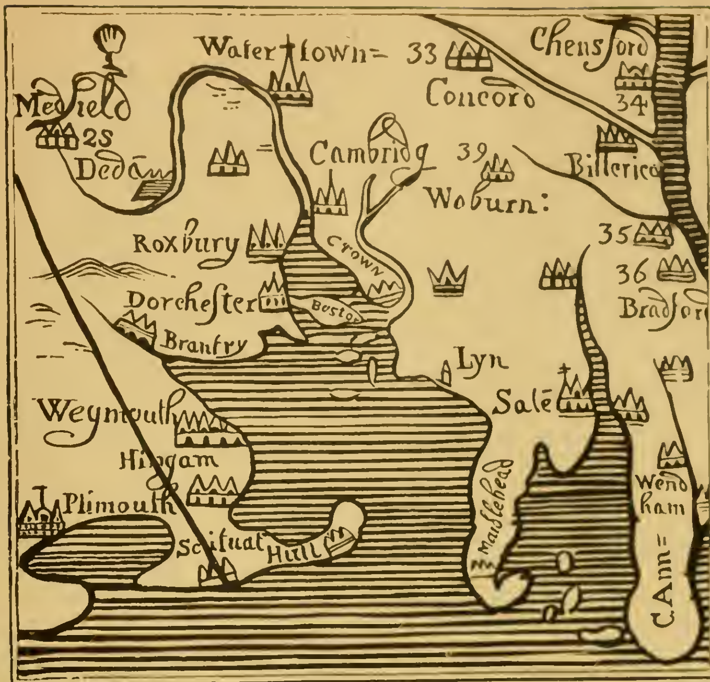
(2.) *Educational Associations.*

The American Institute of Instruction, founded in 1830, the American Association for the Advancement of Education, from 1849 to 1856, and the National Teachers' Association, founded in 1857, have been of great service in raising the standard of educational discussion and diffusing a knowledge of the best methods and true aims of education. But far more broadly useful have been the State Teachers' Associations, acting as they do on much larger bodies of teachers in so many States from year to year.

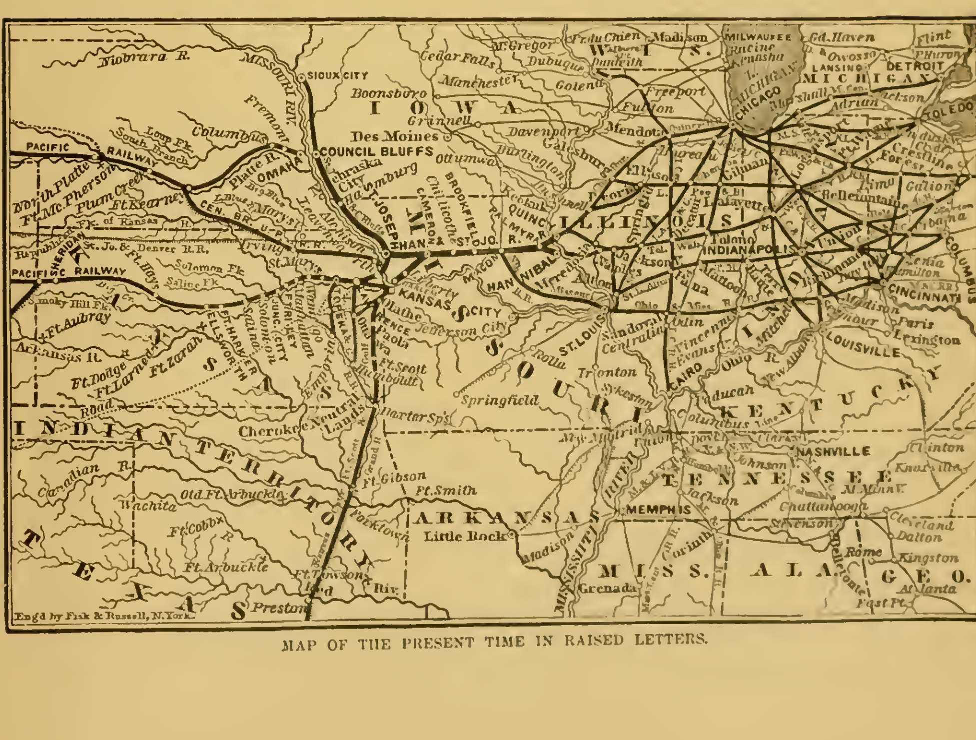
The earliest of the State Associations was that of Rhode Island, which held its first meeting in January, 1845. This was followed by that of New York on July 31st, and of Massachusetts on the 29th of November of the same year. The teachers of Ohio, in 1847; of Connecticut, in 1848; of Vermont, in 1850; of Michigan and Pennsylvania, in 1852; of Wisconsin, Illinois and New Jersey, in 1853; of Iowa, New Hampshire and Indiana, in 1854; of Maine, in 1859; Kansas, in 1862; in California, in 1864; and within five years after the close of the War of Secession, the teachers of every State had organized associations for the improvement of their own profession, and the advancement of the educational interests of the country.

In most of the States, several country societies, and in all the large cities, local associations are in active operation.

The Western College Society originated in the depressed condition of certain colleges in the Western States (Western Reserve, Marietta, Wabash and Illinois Colleges, and Lane Theological Seminary,) which had been aided in their infancy by contributions from sympathizing churches at the East. This depression culminated in the financial reverses of 1837–41—when the investments in buildings and other forms, to the amount of $400,000, seemed likely to be sacrificed for want of immediate aid. In 1842, on the suggestion of Rev. Theron Baldwin, the plan of an association was discussed by various parties interested, and matured in 1843 by the establishment of a Society for the Promotion of Collegiate and Theological Education at the West, by which upwards of a half million dollars

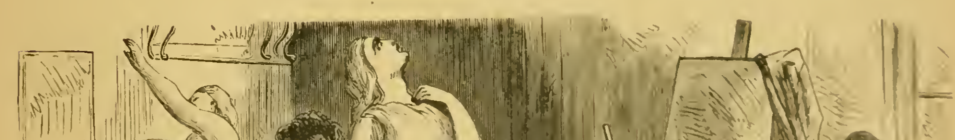



FIRST MAP ENGRAVED IN THE UNITED STATES IN RAISED LETTERS.




MAP OF THE PRESENT TIME IN RAISED LETTERS.

GENTLEMEN ENGAGED IN THE FINE ARTS.



WOMEN ENGAGED IN THE FINE ARTS.

have been contributed to relieve the indebtedness, increase the endowments, and extend the usefulness of the institutions above named, but of more than twice that number of institutions of a similar character. But beyond these palpable results, the addresses and discussions which the judicious and indefatigable secretary and agent, Rev. Dr. Baldwin (the originator of the same), was mainly instrumental in eliciting throughout the Eastern States, has helped to raise the whole course of higher Christian education throughout the whole country. The society has recently extended the field of its beneficent labors, and is now engaged in building anew the crumbling walls of Southern colleges, and breathing fresh life into what war, always barbarous, has left of once flourishing institutions of learning.

These associations are not confined to the male sex, or to institutions in which boys are primarily regarded—many associations, some composed exclusively of women, and more for the advancement of female education, have been started which are still active. Among the earliest and latest is the *Ladies' Association for Educating Females*, in Jacksonville, Illinois, in 1833, and the *Woman's Education Association*, in Boston, in 1872—indication that a want was early felt in one of the newest States, which is not yet met in one of the oldest.

The Sunday School Union, and the educational societies of different religious denominations, are all incorporated associations for special educational purposes.

The American Association for the Advancement of Social Science, or, as it is more generally called, "The Social Science Association," founded in 1862, has, in its annual congresses in different cities, and in the sectional meetings at Boston, justified its existence by the ability with which it has handled many topics belonging to the vexed questions of educational and public economy.

In the development of educational association, the law of affinity, which finally governs all associations, has worked itself out in this wise,—first a general association of all interested in the main object, and by degrees, special associations of those only who are interested in some department of education, or class of institutions—and finally, a gathering of all teachers and educators on ground common to all. In 1853 a few college presidents gathered in an informal way to talk over the condition of their institutions and some of the knotty problems of discipline, and curriculum, until now there is a regular annual meeting of delegates from all the colleges of New England. In Ohio, and in the States farther west, larger and more public associations have been formed. To get opportunities of special discussion, the teachers of Normal Schools held separate meetings at the close of the American Institute, or National Teachers' Association, until in 1869, out of all interested as officers and teachers, the National Educational Association was organized in 1869, with four departments: the first, of School Superintendence; the second, of Normal Schools; the third, of Elementary Schools, and the fourth, of Higher Instruction, each department meeting under its own president, for special papers and disscussions and all the departments meeting together for general purposes.

(3,) *Industrial and Fine Arts.*

The Pennsylvania Academy of Fine Arts, founded in 1806, holds annual exhibitions, and maintains a school for the study of the antique, of the living model, of anatomy, of design, and painting.

The National Academy of Design, founded in New York in 1826, is an association of all the principal artists of the country, and maintains a school of instruction in art, as well as an annual exhibition of great excellence. Its members are divided into two classes or ranks, National Academicians or N. A. and Associates (A. N. A.), who, after two or three years probation, are promoted to the first rank.

The Cooper Union includes a Society of Associates for the promotion of science and art. The American Institute at New York, organized in 1827, has maintained an annual exhibition of the productions of scientific industry, and hold monthly meetings of its members, for the discussion of questions of science as applied to the arts of life.

Nearly every city has now an association to promote, by public exhibition of productions of painting and statuary, a taste for the fine arts, and in all industrial exhibitions whether state, county or municipal, there is generally a department devoted to ideal art. The new art associations in New York and Boston will greatly surpass any thing yet attempted.

* For history of the principal National and State Associations of an educational character down to 1861, see Barnard's *American Journal of Education*, Vols. XV. and XVI.

## VII. EDUCATIONAL PERIODICALS AND REPORTS.

The earliest serial devoted exclusively to education was *The Juvenile Monitor*, issued in New York in 1811, by Albert Picket, who in 1818–19 published, in connection with his son, John W. Picket, *The Academician*, a large octavo, issued semi-monthly, and containing both original and selected articles of great value. Here was issued the first notices of Pestalozzi's and Fellenberg's views and labors, and very valuable chapters from Jardine's Outline of a Philosophical System of Education.

This field of labor remained unoccupied until the appearance of the *American Journal of Education*, commenced January 1st, 1825, at Boston, Mr. T. B. Wait publisher, and edited by Professor William Russell until 1830, when it was continued under the name of the *American Annals of Education;* the Annals appeared until the end of 1839, completing an entire series of fourteen octavo volumes. At different periods, William C. Woodbridge, Dr. William A. Alcott, and Prof. Hubbard (then of Massachusetts, but afterwards of North Carolina College at Chapel Hill,) were editors.

In 1827 the American Educational Society, founded in 1817 for the sole purpose to aid candidates for the ministry through their collegiate and theological studies, issued a quarterly journal devoted to the publication of the proceedings of the society, and to ecclesiastical matters. Under the charge of Prof. B. B. Edwards from 1831 to 1840, and of Dr. Cogswell, this periodical, which assumed in 1831 the name of *Quarterly Register*, devoted a portion of each number to educational intelligence, especially to the history and statistics of colleges, with two or three comprehensive surveys of the whole field of public instruction, founded on the personal observation and special correspondence of the editor, extending over the whole country.

In January, 1836, appeared the first number of the *Common School Assistant*, a quarto-monthly, edited by J. Orville Taylor, and was published at Albany, and afterward at New York, during four years and four volumes, and part of a fifth, ending in 1840. This periodical was energetically and usefully edited, and Mr. Taylor did much for the cause of popular education by publishing a *Common School Almanac*, and delivering forcible and apt addresses on educational subjects in many States of the Union. His expenses were largely sustained by James S. Wardsworth, of Geneseo, N. Y.

In January, 1839, Hon. Horace Mann, Secretary of the Board of Education for Massachusetts, issued the first number of *The Common School Journal* on his private responsibility, and continued its publication monthly to the close of the tenth volume in 1848, when he resigned his position to take his seat in Congress, as the successor of John Quincy Adams in the House of Representatives. The *Journal* was continued through 1852 by William B. Fowle, who had been for several years associated with Mr. Mann as publisher. The fourteen volumes contain all the Reports of the Board and the Secretary during Mr. Mann's connection with the same, and many very valuable articles by himself, and such personal friends as George B. Emerson, LL.D., Dr. S. G. Howe, W. B. Fowle, and others.

In August, 1838, appeared at Hartford, Connecticut, the first number of the quarto *Connecticut Common School Journal*, edited by Henry Barnard, Secretary of the Board of Commissioners of Common Schools, and was published during four years, ending in consequence of the strange reactionary rally which abolished the board in 1842. It contained the state public educational documents of each year beside valuable selections from treatises not readily accessible, and original articles of permanent value. A second series, in octavo form, was commenced by Mr. Barnard in 1850, and continued by him until January, 1854, when he surrendered its care to the Connecticut State Teachers' Association. The interval between 1843 and 1850 was covered by the publication of the *Journal of the Rhode Island Institute of Instruction*, embodying the official documents and action of the editor as Commissioner of Public Schools in that State. In connection with both journals the editor issued a series of *Educational Tracts*, copies of which he arranged with their publishers to have stitched to every Almanac sold in the State.

In August, 1855, Mr. Barnard issued the first number of his *American Journal of Education*, published at Hartford, quarterly, in octavo. This great repository of educational knowledge has been continued to the present time, and its twenty-fourth volume will be completed in 1873. It has accomplished the object set forth by its founder, and constitutes, in the nearly 21,000 pages already issued, the most comprehensive survey of the history, of systems (national, state, and city), and the biography, theory, and practice of instruction in all classes and grades of schools, both in the United States and other countries, to be found in any similar publication in any language.* It must be for many years to come the best available work of reference on all educational topics for the first three-fourths of the nineteenth century. It contains 130 excellent portraits from steel plates of eminent teachers and educators, and over 1,000 illustrations of school architecture. Since the date of his first Journal the growth of educational literature has been rapid. There are now in nearly every State one or more school periodicals of various titles and forms, but usually issued monthly, and in most cases the organs of the Teachers' Associations of their respective States. These are generally well conducted, and the articles contributed by teachers, who are either the appointed editors or correspondents of the periodicals, discuss with much ability topics connected with methodology, and the practical duties and difficulties of the teacher.

Of this class of periodicals the *Massachusetts Teacher*, the organ of the State Teachers' Association, now issuing its twenty-fifth volume; the *Rhode Island Schoolmaster*, and the *Illinois Teacher*, and the *Indiana School Journal* started in 1855; the *Pennsylvania School Journal*, for twenty years conducted by Hon. T. H. Burroughs, have each maintained a high and special reputation.

There are several educational journals of a less local character devoting themselves to the discussion of the principles of education, to the various methods of teaching and discipline, to educational biography, the careful criticism of text-books, and to the current progress of education. Among the best, as well as the most widely circulated of these are the *American Educational Monthly*, published in New York city since 1862, the *College Courant*, published in New Haven since 1865, and the *National Teacher*, edited and published by E. E. White, Columbus, Ohio.

* Volume XXIV (for 1873) contains a General Index, based on the Special Index of each volume, as well as on the Special Treatises which have been made up out of the separate chapters and articles scattered through the entire series.

Most of the leading publishers of school text-books issue, monthly, quarterly, or semi-annual periodicals, containing *some* educational matter, and a great deal commendatory of their own books. The daily and weekly secular, literary, and religious journals have also their educational departments, and in the aggregate do much for the advancement of schools and education. There were in 1872 forty-five periodicals in the United States, monthly and quarterly, devoted exclusively to education, besides a considerable number—college periodicals, literary and educational papers and magazines, reviews, &c.,—which were partially occupied with educational matter. This is a rapid growth since a period of forty years ago, when a single educational periodical found but a scanty and precarious support.

The annual School Reports, national, state, city and town, it is estimated, constitute a library of over 100 volumes, of 600 pages octavo, of ordinary long primer type.

The earliest official and legislative reports on the condition of public schools were issued in New York in 1812, and in Maryland in 1826. The former did not attract much attention until issued by Azariah Flagg, and John A. Dix, who, as Secretary of State, were from 1827 to 1836 *ex officio* superintendents of public schools. But a different character was given to this class of documents when Hon. Horace Mann became Secretary of the Board of Education for Massachusetts, in 1837.

The cause of education has received a new impetus since the close of the war, and especially since 1867, when a Commissioner of Education was provided for by Congress, originally independent, but subsequently as a bureau of the Department of the Interior. Its first commissioner was Hon. Henry Barnard, who was succeeded in 1870 by Gen. John Eaton, Jr. The Department has issued four annual reports, beside a supplementary one on education in the cities and the District of Columbia. These reports contain a vast amount of information in regard to the educational progress of the United States from year to year, but their statistics of colleges and institutions of secondary instruction being collected as unofficial answers to circulars are not always full and reliable, and give, in some instances, an undue prominence to institutions of recent origin and of mainly prospective usefulness.

## VIII. SCHOOL BOOKS AND SCHOOL APPARATUS.

### (1.) *Text-books.*

At the beginning of our national existence, from 1775 to 1784, the Hornbook, Primer, Bible and Psalter were the universal instruments of school instruction till about 1780, and in many of the district schools till 1800. The late Dr. Noah Webster, in some reminiscences of his early school days, addressed to Mr. Barnard and published in the *American Journal of Education* for March, 1840, says, "When I was young the books used were chiefly Dilworth's Spelling-book, the Psalter, Testament, and Bible. No geography was studied before the publication of Dr. Morse's small books on that subject, about the year 1786 or 1787 (Dr. Morse's first little compendium, entitled *Geography made Easy*, was published in 1784). No history was read, as far as my knowledge extends, for there was no abridged history of the United States. Except the books above mentioned, no book for reading was used before the publication of the Third Part of my Institute in 1785. In some of the early editions of that book I introduced short notices of the geography and history of the United States, and these led to more enlarged descriptions of the country. In 1788, at the request of Dr. Morse, I wrote an account of the transactions in the United States after the Revolution; which account fills nearly twenty pages in the first volumes of his octavo editions. Before the Revolution, and for some years after, no slates were used in common schools; all writing and the operations in arithmetic were on paper. The teacher wrote the copies and gave the sums in arithmetic, few or none of the pupils having any books as a guide. The introduction of my spelling-book, first published in 1783, produced a great change in the department of spelling; and from the information I can gain, spelling was taught with more care and accuracy for twenty years or more after that period, than it has been since the introduction of multiplied books and studies. No English grammar was generally taught in common schools when I was young except that of Dilworth.

President Humphrey, of Amherst College, writing of the period between 1790 and 1810, in a letter to Mr. Barnard, says, "Our school-books were the Bible, Webster's 'Spelling-book' and 'Third Part,' mainly. One or two others were found in some schools for the reading classes. Grammar was hardly taught at all in any of them, and that little was confined almost entirely to committing and reciting the rules. Parsing was one of the occult sciences in my day. We had some few lessons in geography, by questions and answers, but no maps, no globes; and as for blackboards, such a thing was never thought of till long after. Children's reading and picture books we had none; the fables in Webster's Spelling-book came nearest to it. Arithmetic was hardly taught at all in the day schools. As a substitute there were some evening schools in most of the districts. Spelling was one of the daily exercises in all the classes."

Hon. Joseph T. Buckingham, whose school days extended from 1786 to 1800, gives the following list of the school books in use at that time, Webster's and Dilworth's Spelling-books, Webster's Third Part, Dilworth's Schoolmaster's Assistant, and the Bible. The late S. G. Goodrich ("Peter Parley") describing a school of his native town as it was from 1803 to 1806, gives the following as the school books, the Catechism (probably the New England Primer), Webster's Spelling-book, the Bible, Daboll's Arithmetic, (which held its place in the schools for nearly thirty-five years), Webster's Grammar—which even the master did not understand—and Dwight's Geography, which had neither maps nor illustrations, and was merely an expanded table of contents of Morse's Universal Geography. The late Salem Town, describing the school in Belchertown, Mass., which was exceptionally well taught by Mr. S. Greene (father of Prof. S. S. Greene, of Brown University), from 1793 to 1800, gives the following list of text-books, Webster's Elementary (this was probably the "American," as the "Elementary" was not published till later), Spelling-book, Alexander's English Grammar, an abridgment of Pike's Arithmetic, the Columbian Orator, Nathaniel Dwight's and Jedediah Morse's small Geographies, this latter having four maps about the size of a man's hand, and a little later, Murray's English Grammer, and English Reader.

We give on the next page the titles of school books printed in this country prior to 1800.

*American Text-books Printed prior to 1800.*

Abel, Thomas, Plane Trigonometry, *Philadelphia*, 1761.
Adam, Alex., Rudiments of Latin Grammar, *Boston*, 1793
Adams, Hannah, History of New England, *Dedham*, 1799.
Alden, Abner, Introduction to Spelling, *Boston*, 1797.
Alsop's Tables, Latin and English.
Alexander, Caleb, Intro. to Speaking and Writing English, [*Boston*, 1794.
" Spelling-book, *Worcester*, 1799.
" Grammatical System, *Boston*, 1792.
" Latin Language, *Worcester*, 1794.
" Grecian Language, *Worcester*, 1796.
" Virgil, translated, with notes, *Worcester*, 1796.
American Latin Grammar, *Providence*, 1791.
Andrews, John, Sheridan's Gram. of Eng. Lang., *Phil.*, 1789.
Arithmetic, Vulgar and Decimal, *Boston*, 1724.
Ash, John, Dictionary of English Language, *Boston*, 1794.
" Grammatical Institute, *Philadelphia*, 1778.
Best, W., Logic in Question and Answer, *New York*, 1796.
Bingham, Caleb, Young Ladies' Accidence, *Boston*, 1785.
" American Preceptor, *Boston*, 1789.
" Columbian Orator, *Boston*, 1797.
" Child's Companion, *Boston*, 1798. [1799.
" Geographical and Astronomical Catechism, *Boston*,
" Juvenile Letters, to assist Composition, *Boston*, 1799.
" Historical Grammar, translated for La Croze, *Boston*.
" Copy-Slips, *Boston*, 1796.
Burr, Jonathan, Compendium of English Gr., *Boston*, 1797.
" American Later Grammar, *Providence*, 1794.
" English Grammar, *Boston*, 1797.
" New American Latin Grammar, *New York*, 1784.
Cæsar, Commentaries, *Worcester*, 1784.
Campbell, George, Philosophy of Rhetoric, *London*, 1776.
Carroll, James, Am. Criterion of Eng. Gr., *New London*, 1795.
Catechism, or Supplies from the Tower of David, *Boston*, 1721.
Catechism, printed for *Dorchester, Mass.*, 1650.
Catechism in the Negro Christianized, *Boston*, 1693.
Cheever, Ezekiel, Short Int. to Latin Tongue (4th Ed.) *Boston*,
Child's New Plaything, a Spelling-book, *Boston*, 1744. [1734.
Cicero's Orations, *Boston*, 1722.
Clap, Thomas, General View of Philosophy, 1743.
" Foundation of Morals, *New Haven*, 1765.
Clark, John, Introduction to Latin, *Worcester*, 1786.
Collection of Psalm Tunes, *Boston*, 1753.
Comly, John, English Grammar Made Easy, *Philadelphia*.
Compendium Logicæ, *Boston*, 1735.
Comprehensive Grammar, *Philadelphia*, 1789.
Colles, C., Geographical Ledger, *New York*, 1794.
Cook, David, American Arithmetic, *New Haven*, 1799.
Corderius, Colloquies, *Boston*, 18th edition, 1789.
Culman, Sentences for Children, *Boston*, 1723.
Daboll, Nathan, Schoolmaster's Assistant, *New London*, 1800.
Dana, Joseph, Lessons in Reading and Speaking, *Boston*, 1792.
Davidson, James, Introduction to Latin Tongue, *Phila.*, 1798.
Dawson, W., Entertaining Amusement, *Philadelphia*, 1754.
De Henseh, H., Practical French Grammar, *New York*, 1796.
Dearborn, Benjamin, Columbian Grammar, *Boston*, 1795.
Dilworth, Thomas, New Guide to English Tongue, *Boston*, 1767.
" Schoolmaster's Assistant, *Hartford*, 1786.
Dixon, Henry, English Instructor, *Boston*, 1736.
Doddridge, Philip, Friendly Instructor, *Boston*, 1749.
Duncan, William, Elements of Logic, *Philadelphia*, 1792.
Dwight, Nathaniel, System of Geography, *Hartford*, 1795.
Eliot, John, Indian Grammar, *Cambridge*, 1664.
" Indian Grammar Begun, *Boston*, 1666.
" Indian Logic Primer, 1672.
" Primer in Indian, 1687.
" Catechism in Indian, 1687.
Enfield, William, The Speaker, *Hudson*, 1778.
English and German Grammar, *Philadelphia*, 1748.
English Tongue—Art of Spelling Improved, *Boston*, 1757.
Ensell, G., Dutch Grammar of English Language, 1797.
Erasmus' Colloquia, *Worcester*, 1785.
Euclid's Elements of Geography, *Worcester*, 1784.
Evans, Lewis, Geographical and Historical Essays, *Phila.*, 1755.
Fenning, Daniel, Universal Spelling-book, *Boston*, 1769.
" Youth's Instructor, *Dover*, 1795.
Ferguson, James, Astronomy Explained, *Philadelphia*, 1799.
Fisher, George, American Instructor, *Philadelphia*, 1748.
Fraser, David, Young Lady's Assistant, *Danbury*, 1794.
Fox, George, Instructions for Right Spelling, *Newport*, 1769.
" Plain Directions for Reading, *Boston*, 1743.
Fiske, Moses, New England Spelling-book.
Gay, Anthelme, Prosodical Grammar, *New York*, 1795.
Gordon, John, Mathematical Traverse Table, *Philadelphia*, 1758.
Gough, John, Treatise of Arithmetic, *Boston*, 1789.
" American Accountant, *Philadelphia*, 1796.
Gros, John D., Moral Philosophy, *New York*, 1795.
Guide to Arithmetic, *Boston*, 1794.
Guthrie, W., Modern Geography, *Philadelphia*, 1795.

Hale, Enoch, A Spelling-book, *Northampton*, 1799.
Haddie, James, Latin Grammar, *New York*, 1791.
Hill, John, Speedy Guide to Learning, *Boston*, 1745.
Holy Bible, common edition, *Worcester*, 1784.
Horace, Odes, *Worcester*, 1784.
Hodder, James, Arithmetic Made Easy, *Boston*, 1719.
Indian Primer, by which children may learn to read the Indian language, *Boston*, 1720.
Introduction to History of America, *Philadelphia*, 1787.
Janeway, James, Token for Children, *Boston*, 1718.
Johnson, S., Compendium of Logic and Ethics, *Phila.*, 1752.
" Elementa Philosophica, *Boston*, 1746.
King's Heathen Gods.
Kinnersley, Ebenezer, Experiments in Electricity, *Phila.*, 1764.
Latin Grammar, for the use of the College, *Philadelphia*, 1773.
Latin Tongue, for Grammar School at Nassau Hall, *Phila.*, 1767.
Lake, John, Maury's Principles of Eloquence, *Albany*, 1797.
Lavoisier, Elements of Chemistry, *Philadelphia*, 1799.
Lee, C. A., American Accountant, *Lansingburgh*, 1797.
Livius, Historiarum Libri quinque priores, *Boston*, 1778.
Logan, James, Cicero's Cato Major, *Philadelphia*, 1744.
Lowth, Robert, Introduction to English Grammar, *Phila.*, 1775.
Macpherson, John, Moral Philosophy, *Philadelphia*, 1791.
Massachusetts Psalter, Indian and English, *Boston*, 1709.
McDonald, Alexander, Youth's Assistant, *Litchfield*, 1789.
Martinet, Catechism of Nature, *Boston*, 1790.
Mennye, J., An English Grammar, *New York*, 1785.
Miller, Alexander, Grammar of English Lang., *New York*, 1795.
Milne, W. The Well-bred Scholar, *New York*, 1797.
Morning and Evening Prayer and Church Catechism in Indian, *Boston*, 1763.
Morse, Jedediah, Geography Made Easy, *New Haven*, 1784.
" " " " *Boston*, 1790.
" American Geography, *Elizabethtown*, 1789.
Murray, Lindley, English Grammar, *New York*, 1795.
Negro Christianized, for instruction of negro servants, *Boston*,
New England Primer, *Boston*, 1692. [1706.
New England Primer Enlarged, *Boston*, 1737.
New England Primer Improved, *Boston*, 1770.
New England Primer, much improved, *Philadelphia*, 1797.
New England Primer Enlarged and Improved, *Charlestown*, 1799.
New and Complete Guide to the English Tongue, *Phila.*, 1740.
New Book of Knowledge, *Boston*, 1762, 1772.
New Introduction to Music, *Boston*, 1764.
Nomenclatura Breves Anglo Latina, *Boston*, 1752.
Otis, James, Latin Prosody, *Boston*, 1760.
Ovid, Metamorphoses.
Parent's Gifts, *Boston*, 1741. [1798.
Perry, William, New Pronouncing Spelling-book, *Worcester*,
Pierce, Spelling-book.
Philadelphia Vocabulary (Latin), *Philadelphia*, 1796.
Pike, Nicolas, New System of Arithmetic, *Newburyport*, 1788.
" Abridged, *Worcester*, 1795.
" Revised by E. Adams, *Worcester*, 1797.
Primer, or the Child's New Plaything, *Philadelphia*, 1757.
Practical Penman, *Albany*, 1727.
Protestant Teacher for Children, with verses made by Mr. John Rogers, martyr in Marie's reign, *Boston*, 1685.
Psalter, or Psalms of David, *Worcester*, 1704.
Root, Erastus, Introduction to Arithmetic, *Norwich*, 1795.
Ross, Robert, American Grammar, *Hartford*, 7th Ed., 1780.
Royal Primer, *Worcester*, 1787.
Rudiments of Latin Prosody, *Boston*, 1760.
Ryland, John, English Grammar, *Northampton*, 1767.
Saunderson, Nicholas, Elements of Algebra, *Cambridge*, 1740.
Scott, William, Lessons in Elocution, *New York*, 1799.
Sheridan, Thomas, Dictionary of Eng. Lang., *Phila.*, 1796.
Shorter Catechism, with Proofs, *Boston*, 1691.
Shorter Catechism, *Boston*, 1739.
Testament, common edition by the dozen, *Worcester*.
Thomas, Alexander, Jr., Orator's Assistant, *Worcester*, 1797.
Ticknor, Elisha, English Exercises, *Boston*, 1792.
Todd, John, American Tutor's Assistant, *Philadelphia*, 1797.
Token for the Children of New England, *Boston*, 1700.
Tuft, John, Easy Method of Singing by Letters, *Boston*, 1723.
Venema, Pieter, Arithmetic of Cijffer Konst, *New York*, 1730.
Vinall, John, Student's Guide in Arithmetic, *Boston*, 1792.
Virgilius, Opera, with Translation, *Worcester*, 1796.
Ward's Latin Grammar.
Watts, Isaac, Catechism and Prayers, *Boston*, 1749.
Webster, Noah, American Spelling-book, *Boston*, 1794.
" Grammatical Institute of Eng. Lang., *Hartford*, 1783.
" " " Part II., *Boston*, 1790.
" " " Part III., *Hartford*, 1792.
Whittenhall, Latin Grammar, *Philadelphia*, 1762.
Young Clerk's Guide to Learning, *Boston*, 1708.
Youth's Instructor, *Philadelphia*, 1745.
Youth's Instructor in the English Tongue, *Boston*, 1726.

(3.) *School Apparatus.*

In the schools of the early period (1775 to 1820) there was little in the way of school apparatus beyond the birchen rod, the strap, the raw-hide, or the ferule, which answered the double purpose of discipline and of assembling the school. The black-board was not introduced into even the city schools earlier than from 1825 to 1830, and did not find its way into the best country schools till after 1840. Globes, imported from England, were found in a few of our colleges perhaps as early as 1800, but did not make their appearance in the public schools before 1850. The orrery, or planisphere, or some other mode of representing the motion of the planets around the sun, were mentioned in some of the books, and heard of as belonging to the college properties of some great institution, but was considered, even as late as 1840, far beyond the reach of a public school. Outline maps, first made by J. H. Mather & Co., though bearing the name of S. A. Mitchell, were introduced in 1840. They were rude compared with those now in the market, and there was a long struggle before they were very generally introduced. Now, one or other of the fifteen or sixteen sets of outline or wall maps are found in all the principal schools; and this plan of illustrating the sciences by wall maps and charts has been extended to physical geography, geology, chemistry, botany, natural philosophy (in a new process of printing on oil-cloth, in Johnson's Philosophical charts), to anatomy and physiology, and even to orthography, phonetics, and grammar.

The earliest, at least one of the earliest, manufacturers of philosophical apparatus in this country was Timothy Claxton, an English mechanic who came to this country in 1823, and worked as a mechanic in a machine-shop connected with a cotton factory in Methuen, Essex County, Mass. In 1826 he removed to Boston, taking with him an air-pump of simple construction, made by himself of a piece of gas-tubing, with a ground brass plate, on a mahogany stand. In a little volume of autobiography entitled *Memoir of a Mechanic*, published in 1839, Mr. Claxton introduces the subject as follows:

"After I had been in Boston three or four years, Mr. Josiah Holbrook, a gentleman much engaged in the establishment of lyceums, came to me to see about apparatus, as he was trying to introduce such cheap and simple instruments into schools, and other seminaries of learning, as would come within their means. He had already several articles for illustrating geometry, astronomy, &c.; but air-pumps were not then simplified enough to form a part of the lyceum apparatus. At this interview, I introduced to his notice a small air-pump for exhausting and condensing, and several articles of apparatus to be used with it, which I had made for the amusement of myself and my friends. He frankly acknowledged it to be the very thing that was wanted in the smaller establishments for education. He wished me to make some for sale, and promised to recommend them, which he did not fail to do. From this interview I may date the commencement of my making philosophical instruments as a regular business."

In the summer of 1835 Mr. Claxton had his shop and warerooms destroyed by fire; but as he was fully insured, he resumed business promptly, taking into partnership his principal workman, Mr. J. M. Wightman, who had been from the first his "right hand man," and who in 1837 took the business off his hands,—Mr. Claxton going to England in the same year. There his zeal for popular education led him to getting up lyceums, and lecturing before mechanics' institutes, and finally to an engagement with the Central Society of Education in London, to superintend the manufacture of school apparatus, similar to what he had been making in Boston. In the meantime Mr. Wightman went on extending his manufacture of apparatus, and by his interest in the better education of mechanics, and the improvement of popular education generally, became an influential member of the school committee, and Mayor of the City of Boston.

The first systematic attempt to supply the Grammar Schools of Boston with a set of philosophical apparatus was made in 1847, under the lead of George B. Emerson, LL. D., the most eminent teacher in the city, and at that time in the school committee. The set was classified and constructed by Mr. Wightman, and was very generally adopted in schools of the same grade in other cities.

The first school apparatus proper for illustrating geography, astronomy, geometry, and arithmetic, which came within the reach of

## SCHOOL APPARATUS.

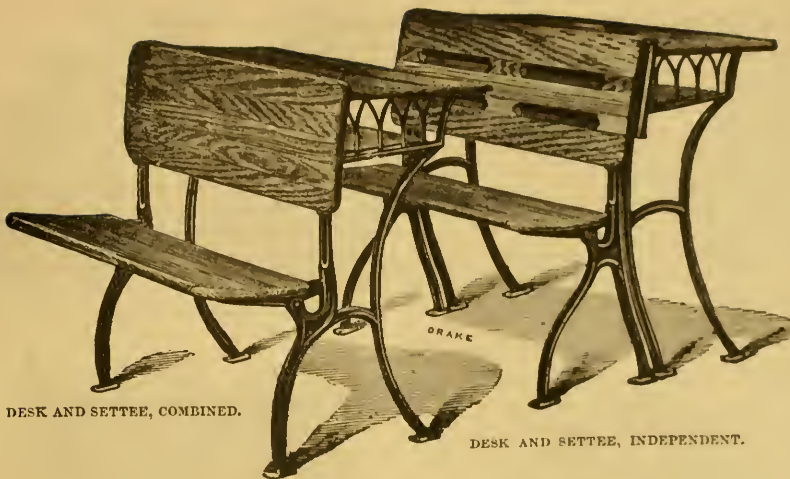
APPARATUS AND EQUIPMENT OF THE DISTRICT SCHOOL AS IT WAS.


SPECIMENS OF APPARATUS OF THE SCHOOL AS IT IS.

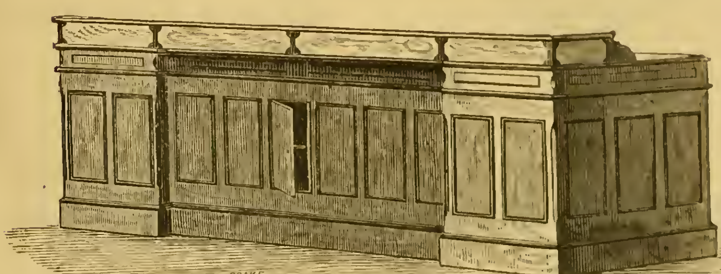
public schools, was that devised by Josiah Holbrook, and manufactured for him after 1835 by his sons, and subsequently by the Holbrook Manufacturing Co. It consisted at first of a five or six inch globe, a three inch globe in halves, a very simple tellurion, a few geometrical forms in wood, and a numeral frame or arithmeticon. These were all at first rude and imperfectly manufactured, but were subsequently greatly improved and other articles added. Competition presently brought several good 6, 8, 10, 12, 18, and 20 inch globes into the market, at reasonable prices, and spelling frames, large slates and frames with wooden panels, covered with liquid slating, slated walls, chalk-rubbers, crayons and crayon-holders, drawing-frames, chemical and philosophical apparatus, planispheres, tellurions, concentric globes, geotellurions, celestial indicators, globe timepieces, microscopes, magic-lanterns, &c., &c., followed in rapid succession, until the furnishing of a school-house cost more than twice or three times what the old school-house, furniture and all, would have required fifty years ago. This, of course, demanded that the school-houses should be more roomy and better built, better arranged, and supplied with better and more comfortable desks and seats than they had been, as will be hereafter described.

There is another improvement of which our fathers had no notion, but which to-day is recognized all over the country,——a supply of reference books for a school and where it can be procured, a district library. No school would now be considered furnished, without Webster's or Worcester's large Dictionary, Lippincott's or some other Gazetteer, Johnson's, or Colton's Atlas, and Johnson's, or Appleton's popular cyclopædias, for reference by both teachers and scholars. If they have a library of choice reading for the pupils and their families, so much the better, and the city and many of the village schools do have this additional means of instruction. In many of the schools, also, there is a cabinet of minerals and geological specimens, not very extensive, but sufficiently so to enable the children to recognize the principal strata, minerals, and elementary bodies which enter into the geology of the neighborhood and the globe. In these matters of apparatus, cabinets, libraries, &c., we are perhaps going to the opposite extreme from that of our fathers, and introducing to the mind of the child so great a variety of objects of thought and study, that no one of them will be completely mastered.

In our city schools, particularly, and to some extent in all the public schools, this multiplicity of studies and objects of thought has put so much work upon the children that there is danger of their more delicately organized and ambitious pupils breaking down under it; and this danger is obviated in a way characteristic of our time, not by abundant and invigorating exercise in the open air, but by exercises which are known as "light gymnastics," the device in part of Mr. Dio Lewis, and in part of Prof. Watson. The apparatus for this purpose consists of wands, wooden rings, wooden dumb-bells, Indian clubs, &c. The Manual of Gymnastics prescribes a great variety of exercises with these, which are so arranged as to keep up the interest of the pupils in them for a long time. These "light gymnastics" unquestionably do something toward invigorating the muscles, and increasing the litheness and dexterity of the pupil, but they are liable to the objection that the mental faculties, already overwearied by the multiplicity of lessons, are still further taxed to remember and go through these calisthenic exercises in their proper order, when the mind should be relaxed from all care and fatiguing thought, while the body is reinvigorated by open air sports and pastimes. Still, in default of any thing better, the "light gymnastics" serve a tolerable purpose. The regulation of the temperature in the school-rooms by a thermometer, and the introduction of good and sufficient means of warming and ventilation, the systemization of the school exercises, recitations, &c., by a programme regularly adhered to, and indicated by the stroke of the teacher's bell, the general abolition of cruel and unusual punishments, the great decline in the use of the rod, strap, or ferule, and the substitution of merit rolls and records, and tokens of honor, are all steps in the progress of education in our public schools, which indicate the improvement which has been made since the days of the vigorous and stern pedagogues of eighty or a hundred years ago.

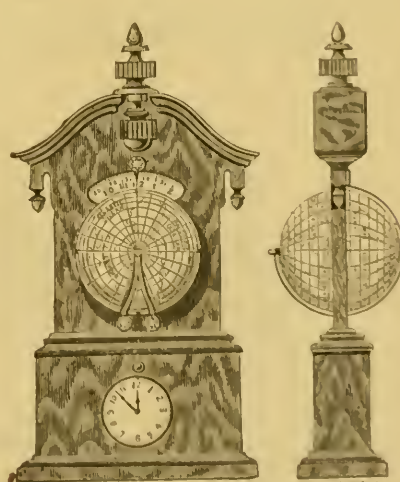



The New American Desks, with Allen's Opera Seats.

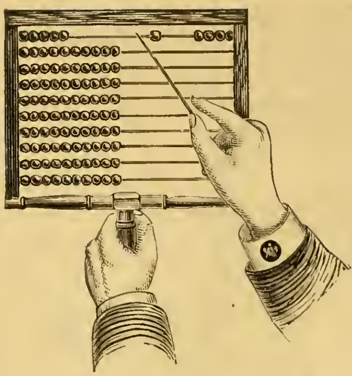



Principal's Platform Desk. (rear view.)

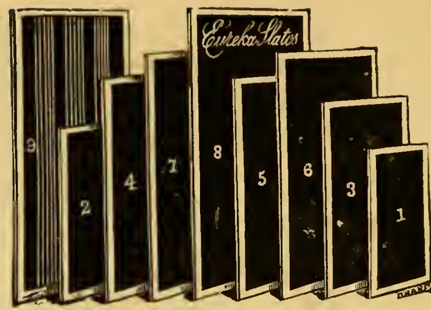
Assistant Teacher's Desk.




Timby's Globe Time-Piece.



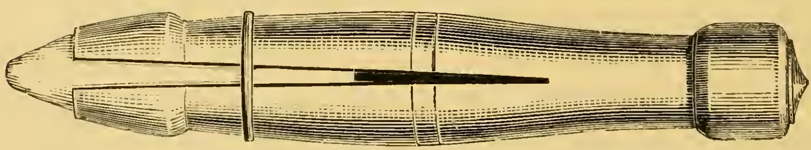
The Abacus, or Numeral Frame



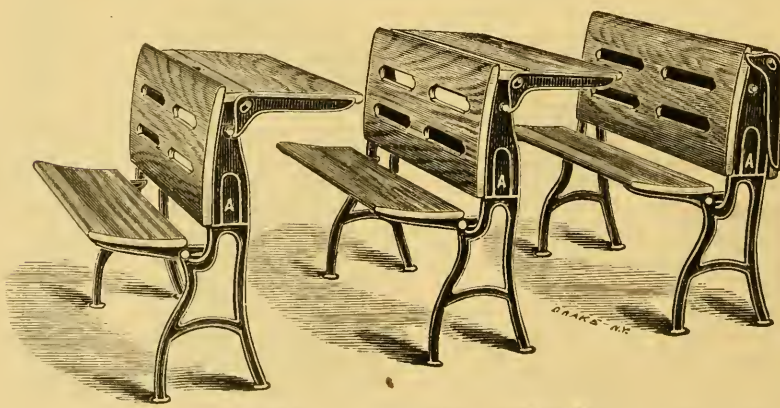

The Eureka Wall-Slates.


The New School Globe.


Hammond Blackboard Support.



The New Crayon-Holder. (full size.)




The "Assembly" School Desks and Settees.

## IX. SCHOOL ARCHITECTURE.

(1.) *School-houses as they were.*

Our illustrations give some idea of the exterior appearance of the rural school-houses of eighty or a hundred years ago, which cast not only their shadows, but projected themselves into our own times. They were generally either log buildings or frame, though occasionally these perversions of architecture were perpetuated in brick or stone. The location, almost invariably chosen for convenience of access to children from widely separated homes, was at the crossing of the roads, and if possible on some knoll, without tree, shrub, or inclosure. If the building was of logs, it was rarely chinked and of course never painted; if a frame building, the weather-boarding was cheap, generally warped, and often detached for fuel or other purposes, and the building, if painted at all, was either red or yellow. We have given elsewhere in this volume descriptions of the interior of some of these school-houses, in different parts of the country, from the pens of the late Dr. Humphrey, S. G. Goodrich, Judge Longstreet, and others. The improvement in these edifices did not begin till after the first quarter of the present century. A writer in the *Educational Monthly*, in 1871, describing a New England school-house, where he had attended school from 1828 to 1830, in a large and wealthy village, gives the following pen-picture:

"It stood upon a little knoll, close to the street, with no inclosure, no trees, and no protection from the gaze of the passers-by. It was a square frame building of one story, about twenty by twenty-five feet, covered with clapboards (except where these had been torn off to aid in kindling the fire) and shingled. The clapboards had at some remote period been painted red, but this now alternated with weather-stains, and gave the building a sort of brindled appearance. Ascending two or three stone steps to the weather-beaten door, the entry, as it was called, presented itself, a square closet where the boys and girls hung hats, bonnets, and dinner-pails. The school-room, into which we next passed, was nearly square; it had been lathed and plastered, but the walls were much broken, and some artistic genius had adorned the wall overhead (the room was hardly seven feet high) with wreaths and festoons and comic figures executed in lamp-smoke, so completely that hardly a vestige of white wall remained. The traditional style of writing-desks, a board attached to the wall and running round three sides of the room, was in use here, but the building committee had kindly provided a shelf below, where our school-books could be stored, when not in use. The seats for the older scholars were of slab, with legs sawed from some sapling about two inches through, and were without backs. The smaller children had similar but lower benches. In the middle of the room was a huge rusty box-stove, which could take in two-foot wood; while on the side unoccupied was the master's chair and a square cross-legged pine table. The teacher's table, the writing-desks, and the benches, bore evidence of the whittling propensities of the boys, and many was the fly-prison and pin-box carved and excavated in the desk-board, while the less expert had cut holes through it, and would amuse themselves with dropping crumbs to the hungry mice which tenanted the school-house."

Henry Ward Beecher thus describes his reminiscence of the *school-house and school* of his boyhood.

"It was our misfortune, in boyhood, to go to a District School. It was a little square pine building, blazing in the sun, upon the highway, without a tree for shade or sight near it; without bush, yard, fence, or circumstance to take off its bare, cold, hard, hateful look. Before the door, in winter, was the pile of wood for fuel, and in summer, there were all the chips of the winter's wood. In winter, we were squeezed into the recess of the farthest corner, among little boys, who seemed to be sent to school merely to fill up the chinks between the bigger boys. Certainly we were never sent for any such absurd purpose as education. There were the great scholars—the school in winter was for *them*, not for us picanninies. We were read and spelt twice a day, unless something happened to prevent, which *did* happen about every other day. For the rest of the time we were busy in keeping still. And a time we always had of it. Our shoes always would be scraping on the floor, or knocking the shins of urchins who were also being 'educated.' All of our little legs together, (poor, tired, nervous, restless legs, with nothing to do,) would fill up the corner with such a noise, that every ten or fifteen minutes the master would bring down his two-foot hickory ferule on the desk with a clap that sent shivers through our hearts, to think how that would have felt, if it had fallen somewhere else; and then, with a look that swept us all into utter extremity of stillness, he would cry, 'silence, in that corner!' It would last for a few minutes; but, little boys' memories are not capacious. Moreover, some of the boys had mischief, and some had mirthfulness, and some had both together. The consequence was that just when we were the most afraid to laugh, we saw the most comical things. Temptations, which we could have vanquished with a smile out in the free air, were irresistible in our little corner, where a laugh and a spank were very apt to woo each other. So, we would hold on, and fill up; and others would hold on and fill up too; till by-and-by the weakest would let go a mere whiffet of a laugh, and then down went all the precautions, and one went off, and another, and another, touching the others off like a pack of fire-crackers! It was in vain to deny it. But as the process of snapping our heads, and pulling our ears went on with primitive sobriety, we each in turn, with tearful eyes, and blubbering lips, 'declared we did not mean to,' and that was true; and that 'we wouldn't do so any more,' and that was a lie, however unintentional; for we never failed to do just so again, and that about once an hour all day long.

"A woman kept the school, sharp, precise, unsympathetic, keen and untiring. Of all ingenious ways of fretting little boys, doubtless her ways were the most expert. Not a tree to shelter the house, the sun beat down on the shingles and clapboards till the pine knots shed pitchy tears; and the air was redolent of hot pine wood smell. The benches were slabs with legs in them. The desks were slabs at an angle, cut, hacked, scratched; each year's edition of jack-knife literature overlaying its predecessor, until it then were cuttings and carvings two or three inches deep. But if *we* cut a morsel, or stuck in pins, or pinched off splinters, the little sharp-eyed mistress was on hand, and one look of her eye was worse than a sliver in our foot, and one nip of her fingers was equal to a jab of a pin; for we had tried both.

"We envied the flies—merry fellows; bouncing about, tasting that apple skin, patting away at that crumb of bread; now out of the window, then in again; on your nose, on neighbor's cheek, off to the very school-ma'am's lips; dodging her slap, and then letting off a real round and round buzz, up, down, this way, that way, and every way. Oh, we envied the flies more than any thing except the birds. The windows were so high that we could not see the grassy meadows; but we could see the tops of distant trees, and the far, deep, boundless blue sky. There flew the robins; there went the bluebirds; and there went we. We followed that old Polyglott, the skunk-blackbird, and heard him describe the way that they talked at the winding up of the Tower of Babel. We thanked every meadow-lark that sung on, rejoicing as it flew. Now and then a 'chipping-bird' would flutter on the very window-sill, turn its little head side-wise, and peer in on the medley of boys and girls. Long before we knew it was in Scripture, we sighed: 'Oh that we had the wings of a bird'—we would fly away and be out of this hateful school. As for learning, the sum of all that we ever got at a district-school, would not cover the first ten letters of the alphabet. One good; kind, story-telling, Bible-rehearsing aunt at home, with apples and ginger-bread premiums, is worth all the school-ma'ams that ever stood by to see poor little fellows roast in those boy-traps called district-schools."

There was some improvement, but not much, in the external construction of school-houses in the large cities of the country, prior to 1840; but the advance (and it has been a great one, amounting to a revolution, though there are even now in all the States too many school-houses answering very nearly to the preceding description) has been mainly since 1838. The progressive development of the literature of this subject is thus given by Hon. E. R. Potter, of Rhode Island, in a report to the National Educational Convention held in Philadelphia in October, 1847, in which he, as the organ of a committee of that body, recommended for general circulation in the United States a small treatise on the location, size, ventilation, warming, and furniture of buildings designed for educational purposes, prepared, at the request of the committee, by Hon. Henry Barnard of Connecticut.

The earliest publication on the subject in this country, which has met the notice of the Committee, may be found in the School Magazine, No. 1, published as an appendage to the Journal of Education, in April, 1829. In 1830, Mr. W. J. Adams, of New York, delivered a lecture before the American Institute of Instruction, "*On School-houses and School Apparatus*," which was published in the first volume of the transactions of that association. Stimulated by that lecture, the Directors of the Institute in the following year offered a premium of twenty dollars for the best "*Essay on the Construction of School-houses.*" The premium was awarded by a committee of the Institute to the essay by Dr. William A. Alcott, of Hartford, Conn., then residing in West Newton, Mass. This "Prize Essay" was published in the second annual volume of lectures before the Institute, as well as in a pamphlet, and was widely circulated and read all over the country. In 1833, the Essex County Teachers' Association published a "*Report on School-houses*" prepared by Rev. G. B. Perry, which is a searching and vigorous exposure of the evils resulting from the defective construction and arrangement of school-houses. From this time the subject began to attract public attention, and improvements were made in the construction and furniture of school-rooms, especially in large cities and villages.

In 1838, Hon. Horace Mann submitted a "*Report on School-houses*," as supplementary to his First Annual Report as Secretary of the Board of Education in Massachusetts, in which the whole subject, and especially that of ventilation, is discurred with great fullness and ability. This Report was widely circulated in a pamphlet form, and in the various educational periodicals of the country, and gave a powerful impulse to improvement in this department, not only in Massachusetts, but in other States. In the same year, Hon. Henry Barnard prepared an "*Essay on School Architecture*," in which he embodied the results of much observation, experience and reflection, in a manner so systematic and practical as to meet the wants of all who may have occasion to superintend the erection, alteration, or furnishing of school-houses. This essay was originally prepared and delivered as a lecture in the course of his official visits to different towns of Connecticut, as Secretary of the Board of Commissioners of Common Schools. It was first published in 1841, in the Connecticut Common School Journal, and in 1842 was submitted, with some modifications and numerous illustrations, as a "*Report on School-houses*," to the Legislature. It may be mentioned as an evidence of the low appreciation in which the whole subject was regarded at that time, in a State which prides herself on the condition of her common schools, and on the liberality with which her system of public education is endowed, that the Joint Standing Committee on education, on the part of the Senate and House, refused to recommend the publication of this Essay, although it is by far the most thorough, systematic and practical discussion of the subject which has appeared in this country or in Europe. And it was only through the strenuous efforts of a few intelligent friends of school improvements that its publication was secured, and then, only on condition that the author should bear the expense of the wood-cuts by which it was illustrated, and a portion of the bill for printing. Since its first publication, more than one hundred thousand copies of the original essay have been printed in various forms and distributed in different States, without any pecuniary advantage to the author. * * * In 1838, Mr. Barnard republished his essay, with plans and descriptions of numerous school-houses which had been erected under his direction in Rhode Island and Connecticut, and after his suggestions in other States, and including all of the plans of any value which had been published by Mr. Mann, Mr. Emerson, Mr. Bishop (the Providence plans), and other laborers in this field at home and in England, with the title of "*School Architecture, or Contributions to the Improvement of School-houses in the United States.*"

Without the remotest thought of ignoring the great services of others in securing local action in this line of improvement, or in extending and perfecting the work in any State, we are satisfied that the first and highest honor in this department of labor belongs to Hon. Henry Barnard,* not only for his early, but for his masterly and exhaustive treatment of the whole subject in 1838, not only to meet the immediate demand, but to leave little or nothing in the way of principles, or details of internal arrangements, to be developed and perfected afterwards. To the following summary of principles set forth in 1838, to be regarded in the location, construction, arrangement of seats and desks, lighting, ventilation, warming, and equipment generally, we find nothing essentially important in the structures erected within the past year.

*School-houses as they should be.*

1. A location, healthy, accessible from all parts of the district; retired from the dust, noise and danger of the highway; attractive, from its choice of sun and shade, and commanding, in one or more directions, the cheap, yet priceless educating influences of fine scenery.

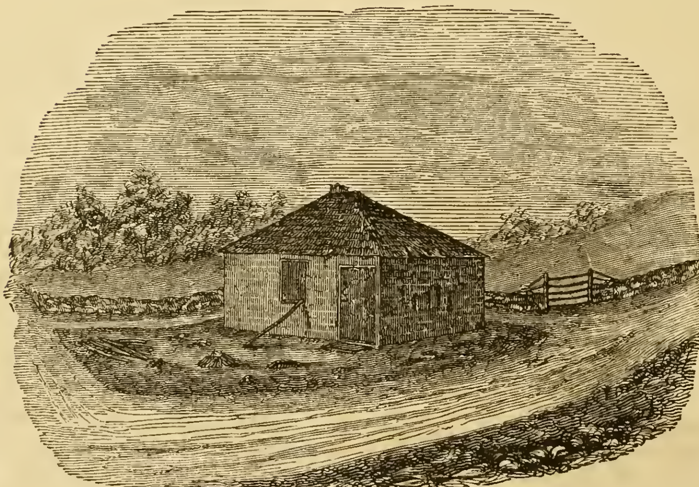
2. A site large enough to admit of a yard in front of the building, either common to the whole school, or appropriated to green-sward, flowers, and shrubbery; and two yards in the rear, one for each sex, properly inclosed, and fitted up with means of recreation and exercise.

3. Separate entrances to the school-room for each sex; each entrance distinct from the front door, and fitted up with scraper, mats, and old broom for the feet; with hooks, shelves, &c., for hats, over-coats, over-shoes and umbrellas; with sink, pump, basin and towels, and with brooms and duster, and all the means and appliances necessary to secure habits of order, neatness and cleanliness.

4. School-room, in addition to the space required by aisles and the teacher's platform, sufficient to accommodate with a seat and desk, not only each scholar in the district who is in the habit of attending school, but all who may be entitled to attend;

* It should be said in justice to Dr. Barnard, whose name appears as the author of this article, that this chapter was written by another hand, and was never seen by him till it was in print. In the Preface to his Principles of School Architecture, Dr. B. gives a chronological history of the previous efforts which had been made to improve the designs, construction and equipment of school-houses. In the revised edition (1873) of the *School Architecture* are upwards of 200 illustrations of buildings recently erected in different parts of the country.

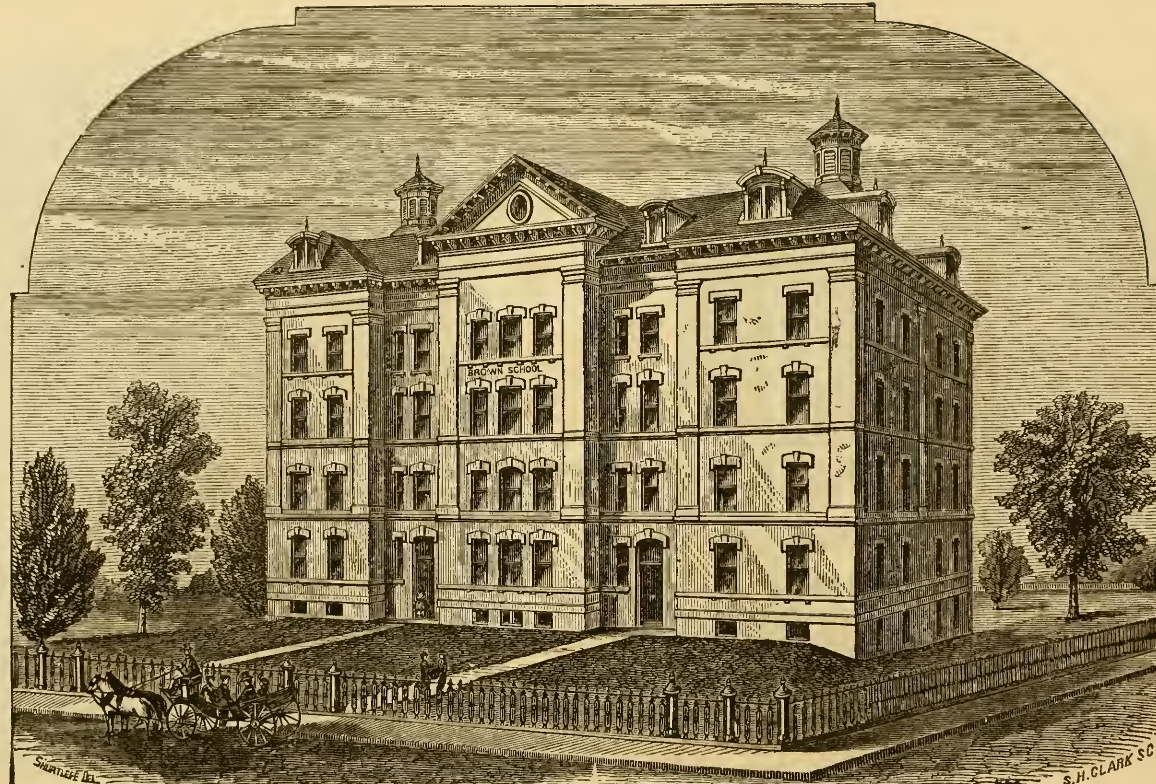
SCHOOL-HOUSES AS THEY WERE.



## SCHOOL-HOUSES AS THEY ARE.

COUNTRY DISTRICT SCHOOL-HOUSE.

VILLAGE SCHOOL-HOUSE.




VIEW OF A SPECIMEN SCHOOL HOUSE OF THE PRESENT DAY.

PACKER COLLEGIATE INSTITUTE.

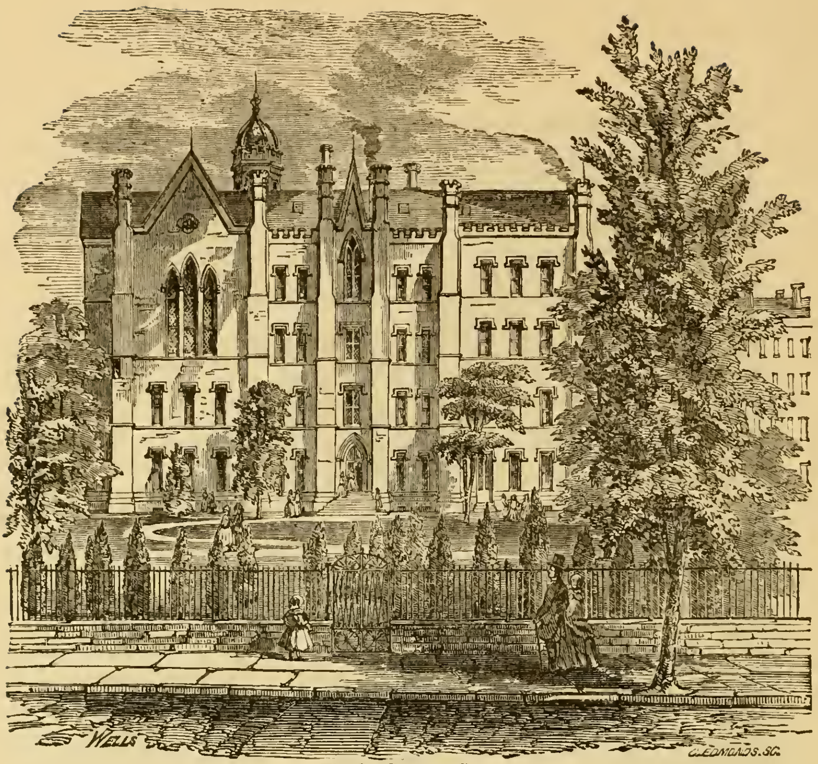



*Fig.* 2. GARDEN FRONT.

Fig. 3. INTERIOR OF CHAPEL.

with verge enough to receive the children of industrious, thoughtful and religious families, who are sure to be attracted to a district which is blessed with a good school-house and a good school.

5. At least one spare room for recitation, library, and other uses, to every school-room, no matter how small the school may be.

6. An arrangement of the windows, so as to secure one blank wall, and at the same time the cheerfulness and warmth of the sunlight, at all times of the day, with arrangements to modify the same by blinds, shutters, or curtains.

7. Apparatus for warming, by which a large quantity of pure air from outside of the building can be moderately heated, and introduced into the room without passing over a red-hot iron surface, and distributed equally to different parts of the room.

8. A cheap, simple, and efficient mode of ventilation, by which the air in every part of a school-room, which is constantly becoming vitiated by respiration, combustion, or other causes, may be constantly flowing out of the room, and its place filled by an adequate supply of fresh air drawn from a pure source, and admitted into the room at the right temperature, of the requisite degree of moisture, and without any perceptible current.

9. A desk with at least two feet of top surface, and in no case for more than two pupils, inclined toward the front edge one inch in a foot, except two to three inches of the most distant portion, which should be level,—covered with cloth to prevent noise,—fitted with an ink-pot (supplied with a lid and a pen-wiper) and a slate, with a pencil-holder and a sponge attached,—supported by end-pieces or stanchions, curved so as to be convenient for sweeping, and to admit of easy access to the seat, —and of varying heights for small and large pupils, the front edge of each desk being from seven to nine inces (seven for the lowest and nine for the highest,) higher than the front edge of the seat or chair attached.

10. A chair or bench for each pupil, and in no case for more than two, unless separated by an aisle, with a seat hollowed like an ordinary chair, and varying in height from ten to seventeen inches from the outer edge to the floor, so that each pupil, when properly seated, can rest his feet on the floor without the muscles of the thigh pressing hard upon the front edge of the seat, and with a proper support for the muscles of the back.

11. An arrangement of the seats and desks, so as to allow of an aisle or free passage of at least two feet around the room, and between each range of seats for two scholars, and so as to bring each scholar under the supervision of the teacher.

12. Arrangements for the teacher, such as a separate closet for his over-coat, &c., a desk for his papers, a library of books of reference, maps, apparatus, and all such instrumentalities by which his capacities for instruction may be made in the highest degree useful.

13. Accommodations for a school library for consultation and circulation among the pupils, both at school and as a means of carrying on the work of self-education at their homes, in the field, or the workshop, after they have left school.

14. A design in good taste and fit proportion, in place of the wretched perversions of architecture, which almost universally characterize the district or public school-houses.

15. While making suitable accommodation for the school, it will be a wise, and, all things considered, an economical investment, on the part of many districts, to provide apartments in the same building, or in its neighborhood, for the teacher and his family. This arrangement will give character and permanence to the office of teaching, and at the same time secure better supervision for the school-house and premises, and more attention to the manners of the pupils out of school. Provision for the residence of the teacher, and not unfrequently a garden for his cultivation, is made in connection with the parochial schools in Scotland, and with the first class of public schools in Germany.

16. Whenever practicable, the privies should be disconnected from the play-ground, and be approached by a covered walk. Perfect seclusion, neatness, and propriety should be strictly observed, and can easily be done wherever water is supplied.

17. A shed, or covered walk, or the basement story paved under feet, and open for free circulation of air for the boys, and an upper room with the floor deafened and properly supported for calisthenic exercises for the girls, is a desirable appendage.

In 1857, Mr. Burrowes, who had been State superintendent of schools in Pennsylvania, after trying in vain to obtain an appropriation for the distribution of Dr. Barnard's "*School Architecture*," to every district in Pennsylvania, prepared a similar work, which was circulated extensively in that State. In 1858, Mr. James Johonnot published a very good treatise on Country School Houses, with numerous illustrations, and in 1872 another with the simple title of "*School Houses*," the architectural designs in which were drawn by S. E. Hewes, architect, and which contained, as an appendix, Messrs. J. W. Schermerhorn & Co.'s Illustrated Catalogue of School Furniture, Apparatus, and Appliances, unquestionably the largest and most complete in the country. In 1861 or 1862, Mr. George E. Woodward, architect and publisher, who had previously published many designs and plans of school-houses, issued a large and elaborate work, Eveleth's School-house Architecture. Several other architectural writers have also published many designs for school-houses very pleasing to the eye, but occasionally defective in their internal arrangements from want of knowledge of the actual requirements of the school. On the subject of ventilation, partly with reference to school-houses, there have been several special treatises by Reid, Gouge, Leeds, &c. Upwards of $100,000,-000 have been invested in the construction and equipment of school-houses in the different States since 1838

### X. BENEFACTORS OF EDUCATION.

No nation, by itself or its citizens, ever dealt so munificently for educational purposes as our own, especially within the past fifteen or twenty years. Prof. Tyndal, in his speech just before his departure from our shores, said: "The willingness of American citizens to throw their fortunes into the cause of public education is without a parallel in my experience." In our early history our people were poor, and the gift of large sums for this purpose was impossible unless the donor lived abroad. Moreover, a moderate sum at that time, with the cheapness of land and the low price of labor and building materials, went farther than a much larger endowment would now; and if the endowment was in lands, and they were retained for many years, there was a greatly enhanced value in the gift. It is not within the limits of our space to name all the early, even, much less of the multitude of later benefactors to education who have done so much to benefit and bless their country; we can only enumerate the more conspicuous among them.

Of the earliest benefactors of education in this country, such men as John Harvard who gave £750 ($3,750) to convert a feeble and ill sustained grammar-school into the first permanent college in America; Edward Hopkins, whose £2,800 ($14,000) founded three grammar-schools and helped to endow a college; Elihu Yale, whose gift of £500 ($2,500) laid the foundations of Yale college: Bartlett and Dummer, and Whitfield, and the long list of worthies who, in colonial times, gave from their moderate means what was perhaps as truly a bounteous gift as the hundreds of thousands or millions of our merchant princes of to-day, we do not propose here to speak. The entire endowments, except lands, of Harvard College up to 1772, were not over $120,000, and a part of these had been destroyed by fire. Yale College had received from 1701 to 1780 from the State and individuals only about $29,000. But the present century has witnessed a constantly swelling tide of educational donations and bequests, whose magnitude is scarcely computable by ordinary figures. The mind takes in only a very imperfect comprehension of the idea of millions of money expended for a particular object, however grand and magnificent in its scope that object may be. The following table, prepared by Dr. Brockett, gives a list of the principal donors of money, in sums exceeding $20,000, to educational purposes within the past hundred years. The list is necessarily imperfect, for there are no data for a complete one, and in many instances donors of large sums have so guarded them with restrictions and conditions that they are unavailable, or the amount can not be ascertained. When we consider that all the 375 colleges and universities, so-called, at least 350 of the schools of secondary instruction, and about 300 professional schools, have been endowed, some of them largely, and all to some extent, and that in most instances these endowments have been raised by contributions varying from $100 to $20,000, we shall realize that this table does not cover half, perhaps not a third, of the educational benefactions of the last hundred years. Thus no part of the $500,000 subscribed for the endowment of Syracuse University; of the $305,000 additional endowment of Tufts College; of the $300,000 additional for Brown University; of the $500,000 now raising by the Alumni of Yale college toward its endowment; of the $500,000 for Union Theological Seminary; of the $260,000 called for by Harvard in consequence of the Boston fire; the $600,000 added to the funds of Trinity College, by Hartford; the $300,000 or more for Hobart College, Geneva; of the $250,000 for Lewisburg University; the $200,000 for Georgetown College, Ky.; the $300,000 now nearly raised for the endowment of the Southern Baptist Theological Seminary at Louisville, and scores of other college and school endowments, which might be named. Yet the benefactions named in this table form an aggregate of over $40,000,000, and we are certainly within bounds if we state the aggregate endowment, including real estate, of our schools, colleges and professional schools, including the State and national grants to them, as exceeding one hundred and fifty millions of dollars; of which not less than one hundred millions is the gift or bequest of individuals.

With such abundant liberality on the part of our citizens, we ought to have all the material conditions of the best schools of secondary and higher instruction; and when we are as well supplied with able and specially trained teachers as with money, we shall have an educational system to meet the demands of the age and the country. At present we have too many colleges whose instruction is not above that of good secondary schools, and too many secondary schools whose principal work is elementary. Were the present endowments concentrated on one-half the number, and these thus enabled to give such salaries as would command the highest order of talent, we should see a rapid improvement in our colleges, and out of the dead level of half-manned and half-equipped institutions would rise a few Universities in fact as well as in name.

There are many lessons to be drawn from the history of endowments, as well in this country, as in Europe, some of which will ere long suggest appropriate legislation to protect the principal, and at the same time admit of such application of the income as to promote and not defeat the evident intention of the donor. While benefactions are useful in providing for educational wants, not generally felt, they not unfrequently prove hindrances in the progressive development of institutions, by being placed beyond the control of their natural guardians, who should be at liberty, under proper restrictions, to apply the same to such studies as new discoveries in science, or new developments in art may require.

The contrast between the slow but gradual accumulation of educational endowments, begun early and continued from year to year, and the recent rapid growth of the funds of of an institution under the joint liberality of the State and a few individuals, is shown in the following statement taken from Barnard's *Educational Biography*, VOLUME III., *Benefactors of American Schools and Colleges*—Ezra Cornell, and John Harvard:

'The rapid growth of Cornell University, both in pecuniary resources, cabinets, professorships, and students, is one of the marvels of educational history. In 1865, on the failure of the attempt in 1856 to establish a State College of Agriculture at Ovid, on Seneca Lake, and of the "People's College" to realize a great State Industrial University at Havana, Mr. Cornell proposed to the legislature of New York, to devote the State share (989,920 acres) in the Congressional land grant of 1862 for the benefit of agriculture and the mechanic arts, to an institution in Ithaca, to the endowment and maintenance of which he would devote the sum of $500,000, and two hundred acres of land, with buildings, as a farm to be attached to the agricultural department. The proposition was accepted, trustees appointed and the institution opened in 1868, under the name of the Cornell University, with Hon. Andrew D. White as president. In 1872, there were 525 college students (exclusive of over 400 in the introductory department), classified in various courses of science, literature, arts, agriculture, architecture, chemistry, engineering, mechanic arts, natural history, and optional studies, under 54 professors, assistant professors, and special lecturers; realizing the idea of the founder—'an institution where any person can find instruction in any study.'

Cornell University, in 1873, possessed the avails, realized and to be realized, of the State appropriation of the Congressional land grant estimated at present prices, at over $2,000,000, and,

DONATIONS BY

| | |
|---|---|
| EZRA CORNELL | $692,000 |
| HENRY W. SAGE, college building, &c | 300,000 |
| JOHN McGRAW, library building, &c | 140,000 |
| ANDREW D. WHITE, president's house | 95,928 |
| HIRAM SIBLEY, building and machinery | 58,000 |
| CASCADILLA COMPANY, building | 35,000 |
| GOLDWIN SMITH, library, &c | 11,800 |
| DEAN GAGE, scholarship | 30,000 |
| BRITISH GOVERNMENT, Patent Office collection, &c. | 11,000 |
| GREEN SMITH, ornithological collection | 5,100 |
| MISS JENNIE McGRAW, chime of bells | 3,150 |
| MRS. A. D. WHITE, great bell | 2,570 |
| WILLIAM KELLEY, mathematical library | 2,000 |
| LEWIS MORRIS, live stock for farm | 2,500 |
| R. HOE & CO., printing press | 3,225 |
| J. E. SWEET, type-setting machine | 2,500 |
| STEWART L. WOODFORD, prize scheme | 1,500 |
| SAMUEL J. MAY, books | 500 |

These amounts, with thirty benefactions in small sums, make an aggregate of $1,402,614, in less than ten years, since the first announcement of Mr. Cornell's intention.

John Harvard was one of the earliest benefactors of American education. Harvard College, to which he left half his property (1750), has been the recipient of more benefactions than any similar institution in the country, a list of which will be found in Barnard's *Benefactors of American Schools*, and in his *History of Superior Instruction in the United States*. We give on the following page the condition of the property as it stood on the treasurer's book, Aug. 31, 1872, amounting to $2,508,256. The grounds, building, museum, apparatus, &c., represent not less than $3,000,000.'

[N. B.—Table referred to on preceding page is not printed.]

## SCHOOL-BOOKS.

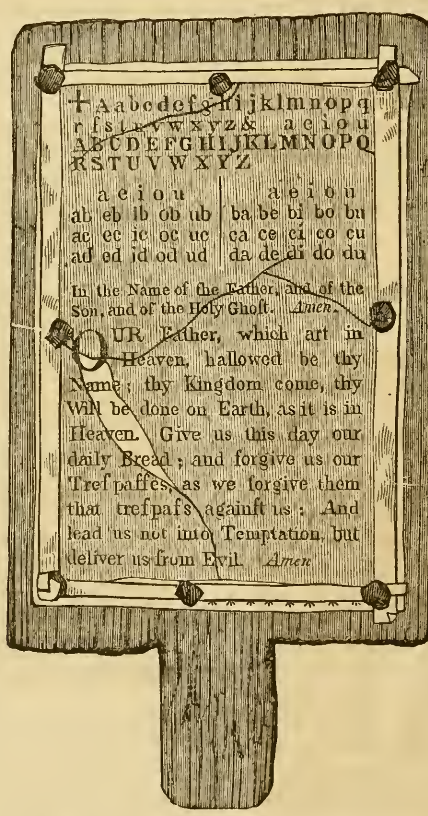
The improvement in the authorship and manufacture of text-books, from the Primer to the Manuals of our colleges and scientific schools, within the last half century is immense. We will refresh the memory of some of our readers by reproducing a few of the tough subjects and illustrations with which they or their fathers were painfully familiar.

### *The Horn-book.*

Few of us have had the satisfaction of learning our letters after the manner described by Prior:—

> "To master John the English maid
> A Horn-book gives of gingerbread;
> And that the child may learn the better,
> As he can name, he eats the letter."

To many, even a picture of the old-fashioned Horn-book—the Primer of our ancestors, consisting of a single leaf pasted on a board, and covered in some instances with thin




HORN-BOOK OF THE EIGHTEENTH CENTURY.

transparent horn to preserve it from being torn or soiled—will be new. The following description and the accompanying cut we copy from Barnard's *American Journal of Education*, for March, 1860:—

Shenstone, who was taught to read at a dame school near Halesowen, in Shropshire, in his delightfully quaint poem of the *Schoolmistress*, commemorating his venerable preceptress, thus records the use of the Horn-book:—

"Lo! now with state she utters her command;
Eftsoons the urchins to their tasks repair;
Their books of stature small they take in hand,
Which with pellucid horn secured are
To save from finger wet the letters fair."

Cowper thus describes the Horn-book of his time:—

"Neatly secured from being soiled or torn
Beneath a pane of thin translucent horn,
A book (to please us at a tender age
'Tis called a book, though but a single page),
Presents the prayer the Saviour deigned to teach,
Which children use, and parsons—when they preach."
*Tirocinium, or a Review of Schools*, 1784.

In "*Specimens of West Country Dialect*," the use of the Horn-book is thus shown:—

"Commether *Billy Chubb*, an breng the hornen book. Gee ma the vester in tha windor, yor *Pal came!*—What! be a sleepid—I'll wake ye. Now, *Billy*, there's a good bway! Ston still there, and mind what I da zâ to ye, an whaur I da point. Now; criss-cross, girt â, little a—b—c—d. That's right, *Billy;* you'll zoon lorn the criss-cross-lain; you'll zoon auvergit Bobby Jiffry—you'll zoon be a *scholard.* A's a pirty chubby bway—Lord lov'n!"

*New England Primer.*

Of the New England Primer we can give no earlier specimen than the edition of 1777, embellished with a portrait of John Hancock, Esq., who was at that time President of the Continental Congress.

The Honorable JOHN HANCOCK, Efq; Prefident of the *American* CONGRESS.

We must not omit the painfully interesting group of John Rogers in the burning faggots, with his wife and nine or ten children—including the one at the breast—a problem which has puzzled many a schoolboy's brain:

MR. JOHN ROGERS, minifter of the gofpel in *London*, was the firft martyr in Queen MARY's reign, and was burnt at *Smithfield, February* 14, 1554.—His wife with nine small children, and one at her breast following him to the ftake; with which forrowful fight he was not in the leaft daunted, but with wonderful patience died courageoufly for the gofpel of JESUS CHRIST.

We are fortunate in being able to present our readers with an exact transcript of the four pages of the first illustrated alphabet printed in this country. Some of our readers may recognize their old friends of the later editions of the Primer, in which "Young Timothy" and "Zaccheus he" were drawn to nature less severely true. The whole belongs to that department of literature which "he who runs may read, and he who reads will run."

A In ADAM's Fall
We ſinned all.

B Heaven to find,
The Bible Mind.

C Chriſt crucify'd
For ſinners dy'd.

D The Deluge drown'd
The Earth around.

E ELIJAH hid
By Ravens fed.

F The judgment made
FELIX afraid.

G As runs the Glass,
Our Life doth pass.

H My Book and Heart
Must never part.

I JOB feels the Rod,—
Yet bleſſes GOD.

K Proud Korah's troop
Was ſwallowed up

L LOT fled to *Zoar*,
Saw fiery Shower
On *Sodom* pour.

M MOSES was he
Who *Israel's* Hoſt
Led thro' the Sea.

N NOAH did view
The old world & new

O Young OBADIAS,
DAVID, JOSIAS
All were pious.

P PETER deny'd
His Lord and cry'd.

Q Queen ESTHER ſues
And ſaves the *Jews*.

R Young pious RUTH,
Left all for Truth.

S Young SAM'L dear
The Lord did fear.

T Young TIMOTHY
Learnt ſin to fly.

U VASTHI for Pride,
Was ſet aſide.

W Whales in the Sea,
GOD's Voice obey.

X XERXES did die,
And ſo muſt I.

Y While youth do chear
Death may be near.

Z ZACCHEUS he
Did climb the Tree
Our Lord to ſee.

## WEBSTER'S SPELLING BOOK.

FEW books have done more to give uniformity to the orthography of the language or to fill the memory of successive generations with wholesome truths than Webster's Spelling Book. Who can forget his first introduction to those four-and-twenty characters, standing in stiff upright columns, in their roman and italic dress, beginning with little *a*, and ending with that nondescript "*and per se;*" or his first lesson in combining letters,

ba be bi bo bu by

Or his joy in reaching words of two syllables,

ba ker bri er ci der

Or his exultation in learning to "know his duty" in those "Lessons of Easy Words" beginning,

No man may put off the law of God:

Or the more advanced steps, both in length of words and stubborn morality, in pursuit of

The wick-ed flee

And closing his spelling career with

Om pom pa noo suc<br>
Mich il li mack a nack

And

Ail to be troubled<br>
Ale malt liquor

In this hasty glance at this famous text book, we have designedly passed over the fables commencing with the Rude Boy and ending with Poor Tray, that we might introduce them all unabridged with their unique illustrations.

*Of the Boy that ſtole Apples.*

AN old man found a rude boy upon one of his trees ſtealing Apples, and deſired him to come down; but the young Sauce-box told him plainly he would not. Won't you? ſaid the old Man, then I will fetch you down; ſo he pulled up ſome tufts of Graſs, and threw at him; but this only made the Youngſter laugh, to think the old Man ſhould pretend to beat him down from the tree with graſs only.

Well, well, ſaid the old Man, if neither words nor graſs will do, I muſt try what virtue there is in Stones; ſo the old Man pelted him heartily with ſtones; which ſoon made the young Chap haſten down from the tree and beg the old Man's pardon.

MORAL.

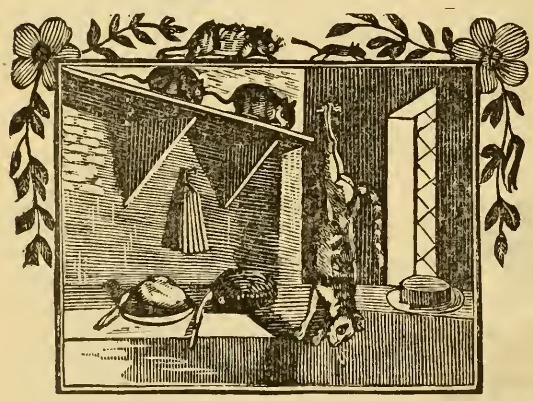
If good words and gentle means will not reclaim the wicked, they muſt be dealt with in a more ſevere manner.

*The Country Maid and her Milk Pail.*

WHEN men ſuffer their imagination to amuſe them, with the proſpect of diſtant and uncertain improvements of their condition, they frequently ſuſtain real loſſes, by their inattention to thoſe affairs in which they are immediately concerned.

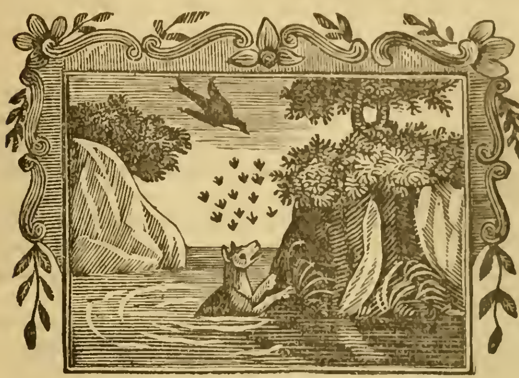
A country Maid was walking very deliberately with a pail of milk upon her head, when ſhe fell into the following train of reflections: The money for which I ſhall ſell this milk will enable me to increaſe my ſtock of eggs to three hundred. Theſe eggs, allowing for what may prove addle, and what may be deſtroyed by vermin, will produce at leaſt two hundred and fifty chickens. The chickens will be fit to carry to market about Chriſtmas, when poultry always bears a good price; ſo that by May Day I cannot fail of having money enough to purchaſe a new Gown. Green—let me conſider—yes, green becomes my complexion beſt, and green it ſhall be. In this dreſs I will go to the fair, where all the young fellows will ſtrive to have me for a partner; but I ſhall perhaps refuſe every one of them, and with an air of diſdain, toſs from them. Tranſported with this triumphant thought, ſhe could not forbear acting with her head what thus paſſed in her imagination, when down came the pail of milk, and with it all her imaginary happineſs.

*The Cat and the Rat.*



A CERTAIN Cat had made ſuch unmerciful havoc among the vermin of her neighbourhood, that not a ſingle Rat or Mouſe ventured to appear abroad. Puſs was ſoon convinced, that if affairs remained in their preſent ſituation, ſhe muſt be totally unſupplied with proviſions. After mature deliberation, therefore, ſhe reſolved to have recourſe to ſtratagem. For this purpoſe ſhe ſuſpended herſelf to a hook with her head downwards, pretending to be dead. The Rats and Mice, as they peeped from their holes, obſerving her in this dangling attitude, concluded ſhe was hanging for ſome miſdemeanour; and with great joy immediately ſallied forth in queſt of their prey. Puſs, as ſoon as a ſufficient number were collected together, quitting her hold, dropped into the midſt of them; and very few had the fortune to make good their retreat. This artifice having ſucceeded ſo well, ſhe was encouraged to try the event of a ſecond. Accordingly ſhe whitened her coat all over, by rolling herſelf in a heap of flour, and in this diſguiſe lay concealed in the bottom of a meal tub. This ſtratagem was executed in general with the same effect as the former. But an old experienced Rat, altogether as cunning as his adverſary, was not ſo eaſily enſnared. I don't much like, ſaid he, that white heap yonder: Something whiſpers me there is miſchief concealed under it. 'Tis true it may be meal; but it may likewiſe be ſomething that I ſhould not reliſh quite ſo well. There can be no harm at leaſt in keeping at a proper diſtance; for caution, I am ſure, is the parent of ſafety.

*The Fox and the Swallow.*



ARISTOTLE informs us, that the following Fable was spoken by Eſop to the Samians, on a debate upon changing their miniſters, who were accuſed of plundering the commonwealth.

A Fox ſwimming acroſs a river, happened to be entangled in ſome weeds that grew near the bank, from which he was unable to extricate himſelf. As he lay thus expoſed to whole ſwarms of flies, which were galling him and ſucking his blood, a ſwallow, obſerving his diſtreſs, kindly offered to drive them away. By no means, ſaid the Fox; for if theſe ſhould be chaſed away, which are already ſufficiently gorged, another more hungry ſwarm would ſucceed, and I ſhould be robbed of every remaining drop of blood in my veins.

*The Fox and the Bramble.*

A FOX, cloſely purſued by a pack of Dogs, took ſhelter under the covert of a Bramble. He rejoiced in this aſylum; and for a while, was very happy; but ſoon found that if he attempted to ſtir, he was wounded by thorns and prickles on every ſide. However, making a virtue of neceſſity, he forbore to complain; and comforted himſelf with reflecting that no bliſs is perfect; that good and evil are mixed, and flow from the ſame fountain. Theſe Briers, indeed, ſaid he, will tear my ſkin a little, yet they keep off the dogs. For the ſake of the good then let me bear the evil with patience; each bitter has its ſweet; and theſe Brambles, though they wound my fleſh, preſerve my life from danger.

*The Partial Judge.*

A FARMER came to a neighbouring Lawyer, expreſſing great concern for an accident which he ſaid had juſt happened. One of your Oxen, continued he, has been gored by an unlucky Bull of mine, and I ſhould be glad to know how I am to make you reparation. Thou art a very honeſt fellow, replied the lawyer, and wilt not think it unreaſonable that I expect one of thy Oxen in return. It is no more than juſtice, quoth the Farmer, to be ſure; but what did I ſay?—I miſtake—It is *your* Bull that has killed one of *my* Oxen. Indeed! ſays the Lawyer, that alters the caſe; I muſt inquire into the affair; and if—And *if!* ſaid the Farmer—the buſineſs I find would have been concluded without an *if*, had you been as ready to do juſtice to others, as to exact it from them.

*The Bear and the two Friends.*

TWO Friends, ſetting out together upon a journey, which led through a dangerous foreſt, mutually promiſed to aſſiſt each other if they ſhould happen to be aſſaulted. They had not proceeded far, before they perceived a Bear making towards them with great rage.

There were no hopes in flight; but one of them, being very active, ſprung up into a tree; upon which the other, throwing himſelf flat on the ground, held his breath and pretended to be dead; remembering to have heard it aſſerted, that this creature will not prey upon a dead carcaſs. The bear came up, and after ſmelling to him ſome time, left him and went on. When he was fairly out of ſight and hearing, the hero from the tree called out—Well, my friend, what ſaid the bear? he ſeemed to whiſper you very cloſely. He did ſo, replied the other, and gave me this good piece of advice, never to aſſociate with a wretch, who in the hour of danger, will deſert his friend.

*The Two Dogs.*

HASTY and inconſiderate connections are generally attended with great diſadvantages; and much of every man's good or ill fortune, depends upon the choice he makes of his friends.

A good-natured Spaniel overtook a ſurly Maſtiff, as he was travelling upon the high road. Tray, although an entire ſtranger to Tiger, very civilly accoſted him; and if it would be no interruption, he ſaid, he ſhould be glad to bear him company on his way. Tiger, who happened not to be altogether in ſo growling a mood as uſual, accepted the propoſal; and they very amicably purſued their journey together. In the midſt of their converſation, they arrived at the next village, where Tiger began to diſplay his malignant diſpoſition, by an unprovoked attack upon every dog he met. The villagers immediately ſallied forth with great indignation, to reſcue their reſpective favourites; and falling upon our two friends, without diſtinction or mercy, poor Tray was moſt cruelly treated, for no other reaſon, but his being found in bad company.

# SUMMARY OF STATISTICS OF UNIVERSITIES AND COLLEGES.

| STATES AND TERRITORIES. | No. of Universities and Colleges. | Preparatory Department: Number of Instructors. | Preparatory Department: Students: Total. | Students: Male. | Students: Female. | Students: Preparing for Classical Course. | Students: Preparing for Scientific course. | Number of Students Unclassified. | Collegiate Department: Corps of Instruction. | Whole No. of Students. | Students in classical course: Male. | Students in classical course: Female. | Students in scientific course: Male. | Students in scientific course: Female. | Collegiate Departm't: Special or optional Students | No. of Graduate Students. | Volumes in Libraries: No. in College Libraries. | Increase in the last Collegiate Year. | No. in Society Libraries. | Property, Income, &c.: Value of Grounds, Buildings and Apparatus. | Amount of Productive Funds. | Income from Productive Funds. | Receipts for the last year from Tuition Fees. | Receipts for the last year from State Appropriations. | Aggregate amount of Scholarship Funds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alabama | 4 | 2 | 53 | 53 | .... | .... | .... | 50 | 53 | 414 | .... | .... | .... | .... | .... | .... | 12,400 | 550 | 3,500 | $505,000 | $302,000 | $24,000 | $2,000 | ........ | ........ |
| Arkansas | 5 | 4 | a231 | 96 | 64 | 43 | .... | .... | 18 | 102 | 24 | 10 | .... | .... | 9 | .... | 1,165 | 150 | ........ | 42,000 | 19,000 | 1,900 | 5,100 | ........ | $1,000 |
| California | 12 | 28 | 1,352 | 1,121 | 231 | 172 | 317 | .... | 170 | 894 | 317 | 58 | 93 | 67 | 119 | 49 | 43,610 | 1,100 | 11,165 | 1,428,000 | 870,000 | 116,055 | 103,400 | $25,000 | ........ |
| Colorado | 2 | 1 | a104 | 36 | 18 | 28 | 26 | .... | 9 | 13 | 9 | 1 | .... | .... | .... | .... | 2,000 | 200 | ........ | 130,000 | ........ | 15,000 | ........ | 7,000 | ........ |
| Connecticut | 3 | ... | ........ | ........ | .... | .... | .... | .... | 120 | 912 | 842 | 5 | 11 | .... | 35 | 49 | 136,275 | 6,050 | 20,000 | 472,884 | 587,055 | 42,709 | 93,221 | ........ | ........ |
| Delaware | 1 | 5 | 56 | 32 | 24 | 6 | 3 | .... | 5 | 50 | 27 | 8 | .... | .... | 13 | 2 | 6,500 | 150 | 2,000 | 75,000 | 83,000 | 4,980 | 540 | ........ | ........ |
| Georgia | 6 | 6 | 221 | 172 | 49 | 79 | 11 | .... | 44 | 441 | 355 | 19 | 10 | 1 | 14 | 4 | 32,213 | 690 | 8,100 | 610,000 | 505,000 | 42,300 | 20,900 | 16,000 | 2,300 |
| Illinois | 28 | 71 | c2,612 | 1,551 | 739 | 555 | 725 | 163 | 201 | 2,211 | b859 | 186 | 261 | 146 | 304 | 12 | 110,893 | 2,318 | 19,950 | 2,498,020 | 2,188,000 | 128,766 | 75,684 | ........ | 93,000 |
| Indiana | 16 | 41 | a1,140 | 887 | 427 | 479 | 358 | 102 | 152 | 1,226 | b701 | 87 | 140 | 36 | 67 | 20 | 58,872 | 650 | 7,053 | 1,185,000 | 715,500 | 47,700 | 18,313 | 23,000 | 25,000 |
| Iowa | 10 | 31 | 1,818 | 1,169 | 649 | 341 | 352 | 71 | 139 | 1,263 | 381 | 170 | 178 | 133 | 39 | 14 | 48,510 | 3,145 | 6,681 | 1,197,000 | 632,027 | 53,700 | 41,380 | 23,600 | 10,500 |
| Kansas | 8 | 11 | 652 | 426 | 226 | 90 | 132 | .... | 62 | 279 | 77 | 19 | 63 | 14 | 103 | 3 | 20,300 | 800 | 2,800 | 499,000 | 58,500 | 4,713 | 7,123 | 29,718 | 12,000 |
| Kentucky | 13 | 18 | 876 | 663 | 213 | 267 | 126 | .... | 76 | 771 | b370 | 106 | 79 | 12 | 8 | 6 | 36,719 | 862 | 14,509 | 642,500 | 486,100 | 25,470 | 37,413 | 600 | 61,000 |
| Louisiana | 7 | 7 | 227 | 194 | 33 | 58 | .... | 103 | 32 | 230 | 18 | .... | 7 | .... | .... | .... | 22,500 | 100 | 2,000 | 170,000 | 278,400 | 19,468 | 4,677 | ........ | ........ |
| Maine | 3 | ... | ........ | ........ | .... | .... | .... | .... | 35 | 422 | 405 | 17 | .... | .... | .... | .... | 39,900 | 469 | 14,600 | 730,000 | 721,238 | 26,050 | 16,576 | ........ | 87,927 |
| Maryland | 8 | 7 | 160 | 133 | 27 | 85 | 17 | 49 | 66 | 1,132 | 146 | 24 | 12 | 2 | 43 | 42 | 39,100 | 200 | 900 | 380,500 | 3,027,570 | 181,734 | 9,902 | 40,065 | ........ |
| Massachusetts | 7 | 1 | 370 | 370 | .... | 150 | .... | .... | 138 | 1,710 | 1,551 | 37 | 22 | .... | 12 | 81 | 267,090 | 13,788 | 16,119 | 1,250,000 | 4,925,317 | 304,107 | 213,850 | ........ | 230,200 |
| Michigan | 9 | 25 | 982 | 574 | 408 | 180 | 186 | 42 | 98 | 1,016 | 156 | 25 | 77 | 59 | 102 | 15 | 50,219 | 3,250 | 5,900 | 1,068,450 | 577,946 | 79,958 | 20,089 | 77,100 | 66,000 |
| Minnesota | 5 | 2 | 438 | 276 | 162 | 117 | 185 | 13 | 55 | 231 | 108 | 10 | 45 | 30 | 41 | .... | 19,604 | 3,156 | 1,315 | 296,870 | 507,387 | 49,081 | 5,139 | 19,000 | 6,160 |
| Mississippi | 5 | 11 | 357 | 357 | .... | 43 | 15 | .... | 25 | 320 | 201 | 9 | 13 | 6 | .... | 7 | 9,600 | 150 | 3,000 | 421,000 | 70,000 | 3,960 | 3,200 | 38,000 | ........ |
| Missouri | 17 | 39 | 1,170 | 1,024 | 146 | 226 | 178 | .... | 157 | 1,265 | 200 | 82 | 43 | 35 | 31 | 22 | 84,425 | 1,339 | 8,709 | 1,149,500 | 739,000 | 155,125 | 51,555 | ........ | 63,550 |
| Nebraska | 3 | 9 | 196 | 141 | 55 | 55 | 93 | .... | 24 | 123 | 36 | 12 | 15 | 9 | 45 | 6 | 3,700 | 450 | 200 | 218,000 | 23,000 | ........ | 5,900 | 25,000 | ........ |
| Nevada | 1 | 1 | 40 | 16 | 24 | .... | .... | .... | 1 | ........ | ........ | .... | .... | .... | .... | .... | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 6,000 | ........ |
| New Hampshire | 1 | ... | ........ | ........ | .... | .... | .... | .... | 20 | 315 | 246 | .... | 69 | .... | .... | .... | 51,835 | ........ | ........ | 100,000 | 450,000 | 25,000 | 21,400 | 1,000 | 100,000 |
| New Jersey | 4 | 10 | 39 | 39 | .... | 7 | 6 | .... | 53 | 663 | 511 | .... | .... | .... | .... | 61 | 53,200 | 3,000 | 4,500 | 1,220,000 | 1,172,812 | 81,003 | 23,765 | ........ | 65,000 |
| New York | 26 | 76 | 1,634 | 1,325 | 309 | 479 | 310 | 379 | 375 | 3,175 | 1,614 | 265 | 472 | 104 | 238 | 29 | 229,841 | 4,114 | 19,309 | 6,353,653 | 8,440,602 | 477,942 | 311,775 | 168,000 | 280,400 |
| North Carolina | 7 | 5 | 259 | 226 | 33 | 148 | 30 | 99 | 42 | 723 | 361 | .... | 33 | .... | 79 | .... | 28,000 | 950 | 37,000 | 481,000 | 165,000 | 10,500 | 18,700 | 369 | 600 |
| Ohio | 3 | 75 | a3,629 | 3,150 | 912 | 993 | 921 | .... | 271 | 2,761 | 1,204b | 103 | 413 | 333 | 216 | 16 | 249,821 | 2,144 | 41,493 | 2,973,336 | 1,713,158 | 177,101 | 53,756 | 23,000 | 121,500 |
| Oregon | 7 | 13 | 741 | 385 | 356 | 158 | 226 | .... | 29 | 218 | 117 | 63 | 42 | 24 | .... | 2 | 8,120 | 130 | 1,800 | 277,000 | 185,782 | 15,600 | 11,238 | ........ | [illegible] |
| Pennsylvania | 27 | 68 | 1,884 | 1,510 | 374 | 783 | [illegible] | 86 | 257 | 1,874 | 1,316b | 111 | 189 | 60 | 71 | 20 | 165,596 | 2,775 | 70,622 | 4,479,500 | 3,151,000 | 181,439 | 130,349 | ........ | [illegible] |
| Rhode Island | 1 | ... | ........ | ........ | .... | .... | .... | .... | 16 | 243 | 108 | .... | 24 | .... | 7 | 14 | 51,000 | ........ | ........ | ........ | 600,193 | 38,077 | 28,032 | ........ | [illegible] |
| South Carolina | 7 | 7 | 366 | 268 | 98 | 124 | 65 | 82 | 37 | 334 | 218 | 2 | 30 | 2 | .... | 4 | 21,780 | 593 | 6,000 | 220,000 | 502,500 | 31,116 | 6,200 | 4,500 | 35,387 |
| Tennessee | 21 | 45 | 1,906 | 1,307 | 599 | 200 | 253 | .... | 118 | 1,100 | b481 | 68 | 87 | 42 | 28 | 13 | 48,837 | 1,095 | 5,795 | 1,247,500 | 1,175,000 | 75,890 | 28,954 | 1,000 | 37,000 |
| Texas | 11 | 25 | a1,051 | 547 | 307 | 161 | 207 | .... | 55 | 930 | 250 | 28 | 27 | .... | 81 | 4 | 14,460 | 1,132 | 1,800 | 409,000 | 35,000 | 1,000 | 38,850 | 175 | ........ |
| Vermont | 3 | ... | ........ | ........ | .... | .... | .... | .... | 15 | 192 | 119 | 8 | 65 | .... | .... | .... | 33,865 | 1,041 | 1,000 | 368,000 | 318,145 | 13,010 | 7,576 | 500 | 57,000 |
| Virginia | 8 | 4 | 131 | 101 | .... | 65 | 11 | .... | 69 | 1,004 | 181 | .... | .... | .... | 69 | 2 | 79,580 | 630 | 25,200 | 1,605,000 | 315,300 | 21,858 | 26,062 | 30,000 | 15,000 |
| West Virginia | 4 | 3 | 122 | 116 | 6 | 42 | 80 | .... | 25 | 260 | 153 | 37 | 48 | .... | 20 | 2 | 9,290 | 520 | 3,500 | 455,000 | 147,000 | 9,800 | 5,390 | 17,500 | ........ |
| Wisconsin | 8 | 17 | 732 | 570 | 162 | 211 | 238 | .... | 94 | 780 | 270 | 67 | 143 | 49 | 92 | 1 | 44,331 | 4,847 | 3,800 | 843,500 | 800,036 | 52,292 | 64,649 | 42,360 | 42,000 |
| Dist. of Columbia | 4 | 1 | 308 | 276 | 32 | 123 | 5 | .... | 34 | 141 | b89 | .... | 8 | .... | .... | 1 | 45,000 | 175 | 4,700 | 770,000 | 240,000 | 8,500 | 8,000 | ........ | 18,340 |
| Utah | 1 | 3 | 136 | 70 | 66 | .... | .... | .... | 3 | ........ | ........ | .... | .... | .... | .... | .... | 2,717 | ........ | ........ | ........ | ........ | ........ | 3,070 | 3,000 | ........ |
| Washington | 2 | 6 | ........ | ........ | .... | .... | .... | 114 | 0 | 127 | 17 | 11 | 5 | 5 | .... | 1 | 1,143 | 62 | ........ | 100,000 | 5,000 | 500 | 2,000 | 1,000 | ........ |
| Total | 358 | [illegible] | [illegible] | 18,181 | 6,779 | 6,576 | 5,621 | 1,353 | 3,203 | 30,368 | 14,152 | 1,651 | 2,724 | 1,169 | 1,880 | 502 | 2,187,932 | 63,675 | 375,302 | $46,871,213 | $37,671,958 | $2,548,321 | $1,555,484 | $922,577 | $1,719,626 |

a Sex not reported in all cases.

b Classification not reported in all cases.

c Income only.

## SECONDARY INSTRUCTION.

After our Public Schools, of which we have given such full statistics in the preceding tables, some schools of secondary or superior instruction, which under a variety of names, form the connecting links between the public school and the college or university. Some of these are private schools but somewhat permanent in character; they may be schools for boys, or for girls, or both; others rank as academies, high schools or seminaries; others still, are preparatory schools for the college course; others still as schools of superior instruction for women, Female Seminaries, Colleges, Academies, or Collegiate Institutes. Still another class, are Commercial or Business Colleges. There are also Normal Schools or Colleges, sometimes private, sometimes State or City institutions, intended for training teachers—and schools of special instruction for deaf mutes, blind, feeble minded, orphans and juvenile offenders. The character of these schools is so diverse that we cannot bring them under a table, showing the number in each State, but we give below the aggregate number of each class in the entire country, with such particulars as can be collected concerning them, premising that a considerable number are not reported in any year.

| CLASSES OF SCHOOLS | No. Schools in U. S. | No. Male Teachers. | No. Fem. Teachers. | Total Number of Pupils. | No. Male Pupils. | No. Female Pupils. | Value of Buildings, Grounds and Apparatus. | Amount of Productive Endowment. | Income from Productive Endowment or State appropriation | Income from all Sources. | No. of Volumes in Library. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Schools & Acad. Boys. Schools & Acad. Girls. Schools, Boys and Girls. } .. | 1,227 | 2,429 | 3,318 | 100,371 | 48,110 | 47,998 | 18,837,114 | 3,171,119 | 165,6 5 | 2,528,4 2 | 513 566 |
| Preparatory Schools........ | 114 | (8 | 16) | 12,538 | ........ | ........ | 4,499,270 | ,206,186 | 76,8 4 | 622,802 | 116,822 |
| Schools, Acads., Sem., Col. & Col. Ins. for superior Instruction of women........ | 925 | 534 | 1,574 | 22,639 | ........ | 22,639 | 8.264.959 | 757,824 | 43,712 | 853 866 | 225 297 |
| Normal Schools and Col.... | 156 | (1, | 227) | 30 669 | 11,589 | 15 27 | ........ | ........ | ........ | 941,575 | 129,333 |
| Com. and Business Col..... | 1 9 | (5 | 27) | 21,048 | ........ | ........ | ........ | ........ | ........ | ........ | 49,986 |
| Kindergarten.............. | 159 | ..... | 376 | 4,797 | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| SPECIAL INSTRUCTION— | | | | | | | | | | | |
| Schools for Deaf Mutes..... | 52 | (3 | 72) | 6,036 | 3 471 | 2,565 | 6.194,690 | ........ | 1,114 834 | 1,253,706 | 39,882 |
| Schools for the Blind. ..... | 30 | (5 | 47) | 2,214 | ........ | ........ | 3,348,699 | ........ | 4 5,002 | 663,416 | 15,117 |
| Schools, feeble minded, Idiotic, etc.............. | 11 | (4 | 22) | 1,981 | 1 110 | 786 | 324.480 | ........ | ........ | 318 823 | ........ |
| Reform Schools............ | 65 | 543 | 453 | 10,8 0 | 3,096 | ........ | ........ | ........ | ........ | 2,532,622 | 38,610 |
| Orphan Asylums, Soldiers' Or. Homes, Infant Asylums and Indus. Schools... | 880 | (3, | 688) | 67,082 | (3, 148) 38,916 | 25.018 | ........ | ........ | ........ | 3 876.426 | 81.179 |
| Totals.............. | ..... | (7. | 511) | ........ | (8, 148) | | ........ | ........ | ........ | ........ | ........ |
| Grand Totals........ | 2 550 | 3 606 | 5,721 | 280,248 | 106 292 | 114.733 | 41,469 212 | 6 135 128 | 1,815 967 | 13,527,667 | 1,209,782 |

## IV. SCIENTIFIC AND PROFESSIONAL SCHOOLS.

There still remains, to complete our summary review of the Educational institutions of this country, some account of the Scientific and Professional Schools or Institutions of the United States. The Scientific Schools are of two classes. Those organized under the law making grants of land to Agricultural Colleges, and receiving the avails of these grants, and those not receiving these avails, but endowed by State or private munificence. The Theological Seminaries and institutions can be classed under a single head, though some of them are connected with Colleges or Universities, and others are independent of these; some have a course of classical study, and others are confined to theological studies exclusively. The Law Schools come under a single head, but the Medical Schools are divided into Regular Homœopathic and Eclectic, and the Dental and Pharmaceutical Schools are also classed with them. We give herewith such statistics as can be obtained of all these Scientific and Professional Schools.

| CLASSES OF SCHOOLS OR INSTITUTIONS IN UNITED STATES. | Number of Schools. | Number of Professors or Instructors. | Whole Number of Students. | Number of Male Students. | Number of Female Students. | No in Preparatory or Partial Course. | No. in Scientific or Professional Course. | Value of Buildings, Grounds Apparatus, &c. | Amount of Productive Endowment. | Income from Productive Endowment. | Income from all Sources. | Number of Scholarships. | Volumes in Library. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. SCIENTIFIC SCHOOLS. | | | | | | | | | | | | | |
| A—Schools endowed from Agricultural gr'nt. | 43 | *a* 5?? | 7 111 | 6,828 | 283 | 2,208 | 4,902 | $7 587,421 | 5,020,446 | 319,503 | 872,905 | 1,192 | 126.901 |
| B—Not thus endowed. | 33 | 549 | 6,042 | 6,042 | .... | 114 | 5,9.8 | 3.068,000 | 1,486 807 | 137.3 8 | 185.150 | 82 | 57,416 |
| II. THEOLOGICAL SCH'LS | 125 | 577 | 4,320 | 4,320 | .... | ...... | 4 3 0 | 5,424.710 | 7,603 858 | 468 504 | 468,5 4 | .... | 655,202 |
| III. LAW SCHOOLS..... | 50 | 196 | 3,012 | 3,012 | .... | ...... | 3,012 | 51, 00 | 168,247 | 15,755 | 118,489 | .... | 86,560 |
| IV. MEDICAL SCHOOLS. | | | | | | | | | | | | | |
| A—Regular Practice.. | 61 | 915 | 8,279 | ...... | .... | ...... | 8,279 | 1,686,950 | 414,347 | 13,186 | 202,584 | .... | 46,065 |
| B—Homœopathic .. .. | 11 | 158 | 1,215 | ...... | .... | ...... | 1,215 | 349.000 | 40,000 | ....... | 97.871 | .... | 39 800 |
| C—Eclectic.......... | 6 | 51 | 448 | ...... | .... | ...... | 448 | 161 000 | ......... | ....... | 8 960 | .... | 3,000 |
| Dental Schools......... | 12 | 161 | 701 | ...... | .... | ...... | 701 | 68,000 | ......... | ....... | 60.734 | .... | 565 |
| Schools of Pharmacy ... | 13 | 52 | 1,187 | 1,187 | .... | ...... | 1,187 | 155,000 | 20,500 | ....... | 47.757 | .... | 5.175 |
| Totals............ | 357 | 2,919 | 32 315 | 21.389 | 283 | 2.322 | 29,993 | 18,549.3 1 | 14,5 4 205 | 954, 46 | 2, 62,984 | 1,274 | 1.0.0.624 |

In most of the Theological Schools, the tuition is provided for by endowment, and is free. The Scholarships of the Scientific Schools cover the tuition; there are also free scholarships in some of the Medical Schools—usually the result of State grants.

*a* Besides those in 17 schools not reported and 27 included under the faculties of the Universities with which these schools are connected. The real number of instructors is about 659.

# EDUCATIONAL STATISTICS FURNISHED BY THE GOVERNMENT BUREAU OF EDUCATION AT WASHINGTON.

## SUMMARY OF SCHOOL AGE, POPULATION, ENROLLMENT, ATTENDANCE, ETC.

| States and Territories. | School age. | School population. | Number between 6 and 16 years of age. | Number enrolled in public schools. | Average daily attendance. | Average duration of school in days. |
|---|---|---|---|---|---|---|
| Alabama | 7-21 | 388,003 | ...... | 179,490 | 117,978 | 80 |
| Arkansas | 6-21 | 247,547 | ...... | 70,972 | ..... | .... |
| California | 5-17 | 215,978 | ...... | 158,765 | 100,966 | 146.6 |
| Colorado | 6-21 | 85,566 | 26,969 | 22,119 | 12,618 | c 89 |
| Connecticut | 4-16 | 140,235 | a 116,860 | 119,694 | b 78,421 | 179.02 |
| Delaware | 6-21 | 35,459 | ...... | 27,823 | ..... | l 158 |
| Florida | 4-21 | 88,677 | ...... | 39,315 | 27,046 | .... |
| Georgia | 6-18 | c 433,444 | ...... | 236,533 | 145,190 | .... |
| Illinois | 6-21 | 1,010,851 | ...... | 704,041 | 431,638 | 150 |
| Indiana | 6-21 | 703,558 | ...... | 511,283 | 321,659 | 136 |
| Iowa | 5-21 | 586,556 | a 375,356 | 426,057 | 259,836 | 148 |
| Kansas | 5-21 | 340,647 | 254,953 | 231,434 | 137,667 | 107 |
| Kentucky | d 6-20 | 545,161 | ...... | 265,581 | a 193,874 | 102 |
| Louisiana | 6-18 | 273,845 | ...... | 68,440 | 45,626 | 118 |
| Maine | 4-21 | 214,656 | ...... | 149,827 | 103,113 | 120 |
| Maryland | 5-20 | e 276,120 | ...... | 162,481 | 85,778 | m 176 |
| Massachusetts | 5-15 | 307,321 | ...... | 308,777 | 233,127 | 177 |
| Michigan | 5-20 | 506,221 | ..... | 362,556 | a 213,898 | 141 |
| Minnesota | 5-21 | f 271,428 | ...... | 180,248 | a 117,161 | 94 |
| Mississippi | 5-21 | 426,689 | ...... | 236,704 | 156,761 | 77.5 |
| Missouri | 6-20 | 723,481 | ...... | 476,376 | a 219,132 | c 100 |
| Nebraska | 5-21 | 142,348 | ...... | 92,549 | a 60,156 | 109 |
| Nevada | 6-18 | 10,592 | ...... | 9,045 | 5,401 | 142.8 |
| New Hampshire | 5-21 | a 71,132 | ...... | 64,341 | 48,966 | 105.3 |
| New Jersey | 5-18 | 330,685 | 281,283 | 204,961 | 115,194 | 192 |
| New York | 5-21 | 1,641,173 | ...... | 1,031,593 | 573,089 | 179 |
| North Carolina | 6-21 | 459,324 | ...... | 225,606 | 147,802 | 54 |
| Ohio | 6-21 | c 1,043,320 | c 770,070 | 747,138 | 476,279 | 150 |
| Oregon | 4-20 | 59,615 | ...... | 37,533 | 27,435 | 89.6 |
| Pennsylvania | 6-21 | g 1,200,000 | ...... | 937,310 | 601,627 | 147 |
| Rhode Island | 5-15 | 52,273 | ...... | 44,780 | 29,065 | 181 |
| South Carolina | 6-16 | h 228,128 | h 228,128 | 134,072 | ...... | 77 |
| Tennessee | 6-21 | 544,862 | ...... | 290,141 | 191,461 | 68 |
| Texas | 8-14 | 230,527 | ...... | 186,786 | ...... | m 73 |
| Vermont | 5-20 | f 92,831 | ...... | 75,238 | 48,606 | 125 |
| Virginia | 5-21 | 555,807 | 383,979 | 220,736 | 128,404 | 113 |
| West Virginia | 6-21 | 210,113 | 160,392 | 142,850 | 91,704 | 99 |
| Wisconsin | 4-20 | 483,229 | ...... | 299,258 | 197,510 | 162.5 |
| Total | .... | 15,127,405 | 2,597,990 | 9,680,403 | 5,744,188 | .... |
| Arizona | 6-21 | 7,148 | ...... | 4,212 | 2,847 | 109 |
| Dakota | 5-21 | 12,030 | ...... | 8,012 | 3,170 | 88 |
| District of Columbia | 6-17 | 43,558 | 40,654 | 26,439 | 20,637 | 193 |
| Idaho | 5-21 | ...... | ...... | 6,758 | ...... | .... |
| Montana | 4-21 | 7,070 | ...... | 3,970 | 2,506 | 96 |
| New Mexico | k 7-18 | e 29,312 | ...... | k 5,151 | ...... | k 132 |
| Utah | 6-18 | 40,672 | ...... | 24,326 | 17,178 | 128 |
| Washington | c 5-21 | c 21,223 | ...... | c 14,032 | c 9,585 | c 87.5 |
| Wyoming | c 7-21 | ...... | ...... | c 2,090 | c 1,287 | .... |
| INDIAN. | | | | | | |
| Cherokees | .... | 5,413 | ..... | 3,048 | 1,845 | .... |
| Chickasaws | .... | ...... | ...... | c 650 | a 426 | .... |
| Choctaws | .... | 2,600 | ...... | c 1,400 | a c 921 | .... |
| Creeks | .... | 3,431 | ...... | c 800 | a c 582 | .... |
| Seminoles | .... | ...... | ...... | c 200 | c 170 | .... |
| Total | .... | 175,457 | 40,654 | 101,118 | 61,154 | .... |
| Grand Total | .... | 15,302,862 | 2,638,644 | 9,781,521 | 5,805,342 | .... |

*a.* Estimated. *b.* For the winter. *c.* In 1879. *d.* For whites; for colored, 6-16. *e.* Census of 1870. *f.* In 1878. *g.* In 1873. *h.* In 1877. *k.* In 1875. *l.* For white schools only. *m.* In the counties.

## SUMMARY OF ANNUAL INCOME AND EXPENDITURES, ETC.

| States and Territories. | Annual Income. | Annual Expenditure. | | | | | Estimated real value of sites, buildings, and all other school property. |
|---|---|---|---|---|---|---|---|
| | | Sites, buildings, furniture, libraries, and apparatus. | Salaries of Superintendents. | Salaries of Teachers. | Miscellaneous. | Total. | |
| Alabama | $388,013 | ...... | $11,872 | $362,593 | $1,000 | $375,465 | $130,067 |
| Arkansas | 256,190 | $16,196 | ...... | 192,665 | 10,347 | *a* 238,056 | 198,608 |
| California | 3,573,108 | 256,659 | *b* 47,286 | 2,207,044 | 400,868 | 2,864,571 | 6,914,303 |
| Colorado | 522,580 | 115,922 | ...... | 186,426 | 93,179 | 395,527 | 682,410 |
| Connecticut | 1,481,701 | 96,494 | 26,441 | 1,011,730 | 273,710 | 1,408,375 | ........ |
| Delaware | 183,313 | ...... | 2,300 | 138,819 | 64,472 | *c* 207,281 | *d* 440,788 |
| Florida | 139,710 | ...... | 8,021 | 97,115 | 3,557 | *a* 114 895 | 132,729 |
| Georgia | 471,029 | ...... | ...... | ........ | ........ | 471,029 | ........ |
| Illinois | 7,836,952 | 709,695 | ...... | *e* 4,587,015 | 2,235,232 | 7,531,942 | 15,875,566 |
| Indiana | 4,402,850 | 410,782 | ...... | 3,365,046 | ........ | *a* 4,491,850 | 11,817,955 |
| Iowa | 5,254,268 | 879,979 | ...... | *e* 2,901,948 | 1,139,321 | 4,921,248 | 9,432,359 |
| Kansas | 2,160,507 | 389,116 | 12,178 | 1,088,504 | 328,589 | 1,818,387 | 4,633,044 |
| Kentucky | 1,031,565 | 16,698 | 36,074 | 736,890 | 13,828 | 803,490 | 2,188,407 |
| Louisiana | 480,320 | ...... | ...... | ........ | ........ | 480,320 | *f* 790,000 |
| Maine | 1,047,715 | 74,801 | 25,489 | *g* 948,096 | ........ | *h* 1,047,681 | 2,995,131 |
| Maryland | 1,483,862 | 148,750 | 34,986 | 1,141,753 | 218,878 | 1,544,367 | ........ |
| Massachusetts | *i* 4,622,609 | 610,586 | 54,920 | *g* 4,491,225 | ........ | 5,156,731 | ........ |
| Michigan | 3,002,032 | 725,722 | ...... | 1,909,941 | 474,252 | 3,109,915 | 10,000,000 |
| Minnesota | 1,582,011 | 157,897 | 54,500 | 993,205 | 500,512 | 1,706,114 | 3,156,210 |
| Mississippi | 740,036 | ...... | 9,088 | 669,393 | ........ | *a* 830,704 | ........ |
| Missouri | 4,020,860 | 137,894 | ...... | 2,218,637 | 678,820 | *a* 3,152,178 | 7,353,401 |
| Nebraska | 1,121,795 | 193,035 | 46,274 | 532,304 | 366,382 | 1,137,995 | 2,064,768 |
| Nevada | 158,947 | 51,905 | ...... | 83,706 | 9,580 | *j* 144,245 | 275,274 |
| New Hampshire | 562,116 | 38,372 | 14,125 | 414,590 | 98,252 | 565,339 | 2,329,913 |
| New Jersey | 1,928,374 | 193,999 | 34,406 | 1,446,178 | 253,791 | 1,928,374 | 6,244,139 |
| New York | 10,412,363 | 1,176,230 | 115,400 | 7,638,922 | 1,481,826 | 10,412,378 | 30,747,509 |
| North Carolina | 399,290 | 16,132 | 15,116 | 318,453 | 3,181 | 352,882 | 179,561 |
| Ohio | 7,185,420 | 798,736 | 96,681 | 5,017,542 | 1,254,004 | 7,166,963 | 21,851,718 |
| Oregon | 303,162 | 87,043 | 7,185 | 210,429 | 9,360 | 314,017 | 567,863 |
| Pennsylvania | 8,046,116 | 952,695 | 79,331 | 4,510,197 | 1,906,790 | 7,449,013 | 25,467,097 |
| Rhode Island | 558,451 | 57,338 | 9,835 | 405,605 | 71,422 | 544,200 | 1,894,122 |
| South Carolina | 440,110 | 13,010 | 18,612 | 287,403 | 5,604 | 324,629 | 351,016 |
| Tennessee | 799,217 | 41,077 | 17,355 | 596,680 | 69,750 | 724,862 | 1,066,995 |
| Texas | 891,235 | 27,565 | 12,648 | 674,869 | 38,264 | 753,346 | ........ |
| Vermont | 417,491 | ...... | 11,239 | 360,320 | 82,726 | 454,285 | ........ |
| Virginia | 1,290,288 | 91,106 | 39,210 | 714,783 | 101,010 | 946,169 | 1,177,545 |
| West Virginia | 791,083 | 74,109 | 9,311 | 522,483 | 110,961 | 716,864 | 1,670,535 |
| Wisconsin | 2,697,800 | 245,843 | 59,655 | 1,568,692 | 356,582 | 2,230,772 | 5,303,298 |
| **Total** | $82,684,489 | $8,805,386 | $909,538 | $54,551,201 | $12,656,050 | $78,836,399 | $177,842,331 |
| Arizona | $67,028 | ...... | ...... | ........ | ........ | $61,172 | $113,074 |
| Dakota | 124,903 | $41,031 | ...... | $64 318 | $19,134 | 124,483 | *k* 133,952 |
| District of Columbia | 476,957 | 46,349 | $10,860 | 277,012 | 104,346 | 438,567 | 1,206,355 |
| Idaho | 51,530 | ...... | ...... | 33,844 | 4,968 | 38,812 | ........ |
| Montana | 78,730 | ...... | ...... | ........ | ........ | 59,463 | 118,912 |
| New Mexico | *l* 25,473 | ...... | ...... | *l* 15,432 | *l* 3,458 | *l* 18,890 | ........ |
| Utah | 132,194 | 25,816 | 1,500 | 100,343 | 4,535 | 132,194 | 372,723 |
| Washington | *k* 105,520 | *k* 14,592 | *k* 2,883 | *k* 94,019 | *k* 2,885 | *k* 114,379 | *k* 220,405 |
| Wyoming | *k* 7,056 | ...... | ...... | *k* 22,120 | ........ | *k* 22,120 | *k* 61,675 |
| INDIAN. | | | | | | | |
| Cherokees | 60,803 | ...... | ...... | ........ | ........ | 60,803 | ........ |
| Chickasaws | 58,000 | ...... | ...... | ........ | ........ | 58,000 | ........ |
| Choctaws | 31,700 | ...... | ...... | ........ | ........ | 31,700 | ........ |
| Creeks | 28,356 | ...... | ...... | ........ | ........ | 28,356 | ........ |
| Seminoles | 7,500 | ...... | ...... | ........ | ........ | 7,500 | ........ |
| **Total** | $1,255,750 | $127,788 | $15,243 | $607,088 | $139,326 | $1,196,439 | $2,227,096 |
| **Grand Total** | $83,940,239 | $8,933,174 | $924,781 | $55,158,289 | $12,795,376 | $80,032,838 | $180,069,427 |

*a.* Items not fully reported. *b.* Paid out of the general fund of the counties, and therefore not included in State expenditure. *c.* Includes $1,690 expended for colored schools outside of Wilmington. *d.* For white schools only. *e.* Includes salaries of superintendents. *f.* In 1878. *g.* Includes miscellaneous expenditure. *h.* So reported, though the items given amount to $1,048,386. *i.* Total of reported items. *j.* So reported, though the items given amount to $145,191. *k.* In 1879. *l.* In 1875.

## SUMMARY OF THE NUMBER OF TEACHERS EMPLOYED IN THE PUBLIC SCHOOLS, AND THE AVERAGE MONTHLY SALARY OF TEACHERS IN THE RESPECTIVE STATES AND TERRITORIES.

| States and Territories. | Number of Teachers. | | Average Monthly Salary. | |
|---|---|---|---|---|
| | Male. | Female. | Male. | Female. |
| Alabama | 2,914 | 1,671 | $(*a* 20.96) | |
| Arkansas | 1,432 | 395 | *b* $50.00 | *b* $40.00 |
| California | 1,208 | 2,987 | 80.26 | 61.73 |
| Colorado | 247 | 431 | *c* 42.84 | *e* 40.87 |
| Connecticut | *d* 746 | *d* 2,354 | 56.43 | 35.45 |
| Delaware | (594) | | *a* 30.83 | *a* 24.79 |
| Florida | 675 | 420 | (*b* 40.00) | |
| Georgia | (6,000) | | 50.00 | 30.00 |
| Illinois | 8,834 | 13,421 | 41.92 | 31.80 |
| Indiana | 7,802 | 5,776 | 37.20 | 35 20 |
| Iowa | 7,254 | 14,344 | 31.16 | 26.28 |
| Kansas | 3,506 | 4,274 | 32.47 | 25.98 |
| Kentucky | 4,418 | 2,346 | (*e* 21.75) | |
| Louisiana | (2,025) | | (27.50) | |
| Maine | *f* 2,325 | *f* 4,609 | 32.97 | 21.68 |
| Maryland | 1,330 | 1,795 | (41.06) | |
| Massachusetts | 1,133 | 7,462 | 67.54 | 30.59 |
| Michigan | 4,072 | 9,877 | 37.28 | 25.73 |
| Minnesota | 1,874 | 3,431 | 35.29 | 27.52 |
| Mississippi | 3,411 | 2,158 | (30.05) | |
| Missouri | 6,068 | 4,379 | *g h* 35.00 | *g h* 30.00 |
| Nebraska | 1,670 | 2,430 | 36.12 | 31.92 |
| Nevada | 92 | 105 | 101.47 | 77.00 |
| New Hampshire | 580 | 2,880 | 34.12 | 22.23 |
| New Jersey | 991 | 2,486 | 55.82 | 32.90 |
| New York | 7,992 | 22,738 | (41.40) | |
| North Carolina | 3,040 | 1,090 | (21.75) | |
| Ohio | 11,326 | 12,358 | 56.00 | 39.00 |
| Oregon | 635 | 679 | 44.19 | 33.38 |
| Pennsylvania | 9,732 | 11,613 | 32.36 | 28.42 |
| Rhode Island | 294 | 1,001 | 70.21 | 42.99 |
| South Carolina | 1,887 | 1,284 | 25.24 | 23.89 |
| Tennessee | 4,707 | 1,247 | (26.66) | |
| Texas | 3,083 | 1,278 | ........ | ........ |
| Vermont | 725 | 3,601 | 27.84 | 17.44 |
| Virginia | 3,009 | 1,864 | 29.20 | 21.65 |
| West Virginia | 3,104 | 1,030 | (28.19) | |
| Wisconsin | 2,918 | 7,197 | *i* 37.14 | *i* 24.91 |
| Total number of teachers in States | (280,034) | | ........ | ........ |
| Arizona | 48 | 53 | 83.00 | 70.00 |
| Dakota | 134 | 152 | 26.70 | 21.90 |
| District of Columbia | 31 | 399 | 90.16 | 62.24 |
| Idaho | (*j* 160) | | 85.00 | ........ |
| Montana | 62 | 99 | 71.64 | 56.41 |
| New Mexico | *k* 132 | *k* 15 | ........ | ........ |
| Utah | 282 | 235 | *b* 35.00 | *b* 22.00 |
| Washington | *g* 236 | *g* 324 | *g* 41.14 | *g* 33.34 |
| Wyoming | *g* 20 | *g* 29 | (*g* 55.94) | |
| **INDIAN.** | | | | |
| Cherokees | (*l* 196) | | ........ | ........ |
| Chickasaws | | | ........ | ........ |
| Choctaws | | | *g* 50.00 | *g* 50.00 |
| Creeks | | | ........ | ........ |
| Seminoles | | | *g* 50.00 | *g* 50.00 |
| Total number of teachers in Territories | (2,610) | | ........ | ........ |
| Grand Total | (282,644) | | ........ | ........ |

*a*. For white teachers. *b*. In 1878. *c*. In ungraded schools; in graded schools the average salary of men is $101.75; of women, $64.39. *d*. Estimated. *e*. In cities and towns organized as one district the average salary of men is $98; of women, $43. *f*. Number of males employed in winter; number of females in summer. *g*. In 1879. *h*. In graded schools the average salary of men was $87; of women, $40. *i*. In the counties; in the independent cities the average salary of males is $85.74; of females, $35.06. *j*. Number necessary to supply the schools; actual number of schools 155. *k*. In 1875. *l*. In 1877.

## SUMMARY OF PER CAPITA EXPENDITURE.

| States and Territories. | Expenditure in the year per capita of the school population. | Expenditure in the year per capita of pupils enrolled in public schools. | Expenditure in the year per capita of average attendance in public schools. | Expenditure in the year per capita of population between 6 and 16. | Expenditure in the year per capita of population between 6 and 16 including interest on the value of all school property. |
|---|---|---|---|---|---|
| Massachusetts | *a* $14.91 | *a* $14.93 | *a* $19.66 | ...... | ...... |
| California | *b* 12.44 | *b* 17.17 | *b* 27.35 | ...... | ...... |
| Montana | *b* 11.51 | *b* 17.07 | *b* 24.15 | ...... | ..... |
| Colorado | 11.07 | 17.80 | 31.28 | $14.60 | ...... |
| Connecticut | 9.39 | 11.01 | 17.91 | 11.28 | ...... |
| District of Columbia | 9.06 | 14.87 | 19.14 | 9.74 | $11.52 |
| Rhode Island | 9.03 | 11.63 | 17.35 | ...... | ...... |
| Iowa | *a* 8.17 | *a* 11.25 | *a* 18.45 | *a* 12.77 | *a* 14.14 |
| Nebraska | 7.99 | 12.29 | 18.91 | ...... | ...... |
| Arizona | *c* 6.92 | *c* 8.00 | *c* 24.03 | ...... | ...... |
| Illinois | 6.70 | 9.61 | 15.68 | ...... | ...... |
| Delaware | *d* 6.39 | *d* 8.12 | ...... | ...... | ...... |
| New York | 6.34 | 10.09 | 18.16 | ...... | ...... |
| Ohio | 6.15 | 8.59 | 13.47 | 8.33 | 9.97 |
| Vermont | 5.93 | ...... | 9.18 | ...... | ...... |
| Indiana | 5.80 | 7.96 | 12.72 | ...... | ...... |
| Michigan | *b* 5.70 | *b* 8.11 | ...... | ..... | ...... |
| Kansas | 5.33 | 7.85 | 13.20 | 7.67 | 8.00 |
| Oregon | 5.27 | 8.37 | 11.44 | ...... | ...... |
| Maryland | 5.00 | 8.64 | 16.37 | ...... | ...... |
| Washington | *b* 4.72 | *b* 8.15 | *b* 11.92 | ...... | ...... |
| Wisconsin | 4.65 | 7.51 | 11.37 | 9.79 | 11.33 |
| Maine | 4.56 | 6.53 | 9.48 | ...... | ...... |
| Utah | *c* 3.33 | *c* 5.25 | *c* 7.63 | *c* 3.33 | ...... |
| New Jersey | 3.23 | 9.48 | 16.82 | 6.21 | 8.08 |
| West Virginia | 3.01 | 4.43 | 6.90 | ...... | ...... |
| Louisiana | *b* 1.59 | *b* 6.74 | ...... | ...... | ...... |
| Mississippi | 1.56 | 2.70 | 4.01 | ...... | ...... |
| Virginia | 1.52 | 3.82 | 6.57 | 2.20 | 3.38 |
| South Carolina | 1.42 | 2.42 | ...... | ...... | ...... |
| Kentucky | 1.29 | 3.85 | 5.97 | ...... | ...... |
| Georgia | 1.08 | 1.99 | 3.31 | ...... | ...... |
| North Carolina | 98 | 1.12 | 2.34 | ...... | ...... |
| Alabama | 96 | 2.09 | 3.17 | ...... | ...... |
| Minnesota | ...... | *b* 8.42 | ...... | ...... | ...... |
| Pennsylvania | ...... | *c* 7.61 | *c* 11.81 | ...... | ...... |

*a*. Estimated. *b*. In 1879. *c*. In 1878. *d*. Does not include expenditure for books.

# EXTRACTS FROM COMMENDATIONS.

The following Testimonials must convince the most sceptical person of the merits of this work. We do not remember of ever seeing a list of names attached to any publication in this country whose opinions are entitled to more confidence. They were not given hastily, without examination, as it required about one year to obtain them.

PUBLISHERS.

No. 1.

From President Hobart College, Geneva.

I have examined, as far as time would allow, your new work, on the "Progress of our Country." I think it a very convenient book of reference, and a valuable addition to our statistical knowledge. I have already found it a very useful work to consult, and I gladly add it to our College Library, where it well deserves a place.

No. 2.

From President of the Indiana State University, Bloomington, Ind.

I have examined your recently published work on the "Progress of our Country;" and from the examination I have been able to give it, I believe that it merits richly the highest commendation. The great variety and importance of the subjects, the felicitous style in which they are clothed, and their numerous and beautiful illustrations, render this work peculiarly attractive. They embrace subjects of great and universal utility, and deeply interesting to all classes of community. Every profession and calling in life is here exhibited, with the latest improvements in every department of industry and art. The advancement made during eighty years, in the American republic, is unparalleled in the history of the world; and will remain a proof to all coming generations, of the blessings of free institutions, and the capability of man, under a system of self-government, for an almost indefinite progress in civilization. This work should be in every library, public and private, and in the hands of every citizen.

No. 3.

From the President of the Wesleyan University, Middletown, Conn.

I have examined, with much pleasure and profit, the work on the "Progress of our Country." It contains a great amount and variety of information, printed in an attractive style, on subjects of the highest importance. It is eminently a practical work, and brings within the reach of all, stores of knowledge heretofore inaccessible to most readers. The novelty of the title, the great truths illustrated and established, give it increased attractiveness and usefulness. The patriot and the philanthropist will be encouraged by its perusal and stimulated to greater exertions to secure further progress in all good things in our country and throughout the world.

The enterprising publisher has not spared expense in the manufacture of the work. The printing and the abundant illustrations are in the highest style of art. One of the best illustrations of "Eighty Years' Progress," would be found in the comparison of the mechanical execution of this work with that of any work issued eighty years ago.

No. 4.

From President of Girard College, Philadelphia, Pa.

*Dear Sir,*—I have been interested and instructed by the perusal of your national work, on the "Progress of our Country," for a copy of which I am indebted to your courtesy.

An illustrated history of the various branches of industry and art in the United States, prepared with the ability and truthfulness which characterizes this work, will be highly acceptable to all classes of readers. In its artistic and mechanical execution, nothing has been left to be desired. I am not acquainted with any work in which so much reliable information on so great variety of subjects may be found in so small a compass. It is emphatically a book for the people.

No. 5.

From the President of Genesee College.

LIMA, *November* 6,

With as much care as my time would allow, I have examined the work of Mr. Stebbins, on the "Progress of our Country." It contains a large amount of valuable information, in just the form to be circulated widely among the people. It is in fact a brief and interesting history of our progress as a nation, in both science and the arts. I am willing that my name and influence should aid in its circulation.

No. 6.

From the President of Cambridge University.

CAMBRIDGE,

*Dear Sir*,—I have examined the work on the "Progress of our Country," with such attention as I could give it. I am not competent to verify the statements of many parts, but the names of the gentlemen who contributed some of the most important portions seems to be a sufficient guaranty of their accuracy. I have no doubt the volumes contain much valuable information on the practical arts and industrial interests of the country.

No. 7.

From the President of Marietta College, Ohio.

*Dear Sir*,—The work on the " 260 *Years' Progress of the United States*" was received by mail a few days since. I have given what attention I could to it, and write you now, as I am expecting to be absent from home for some days.

The examination of this work has given me much pleasure. The idea of furnishing this most valuable knowledge in a comparatively small compass, was a most happy one. As a people we want information—reliable information. We need to know our own history, in art and science, as well as in government. The people of one section should know how those of others live—the progress of one should be made known to all.

The idea of the work you have undertaken seems to have been well carried out, as well as happily conceived. On a great variety of topics, in which all the people are interested, you have furnished a large amount of valuable information. All, except those of the lowest grade of intelligence, will avail themselves of the opportunity to secure this volume, and, unlike many books, the more it is examined the more valuable will it seem. I anticipate for it a wide circulation.

I feel great interest in the character of the books distributed through the country. We teach our young people, at great cost, to read. Many, having acquired the art, have no disposition to use it; and others read nothing that has any value. Good books, *books*—not newspapers, they will take care of themselves—should be in every house. Hence, I favor school libraries, as an easy and cheap method of putting good books into the hands of the young. For a like reason I rejoice in the purchase, by families, of all good works.

This work on the Progress of the United States, will serve a most excellent purpose in two ways. It may be taken up at any time to employ a few leisure moments, and it serves as an encyclopædia for reference.

Please accept my thanks for the volume, and my best wishes for its wide-spread distribution.

No. 8.

From the President of the University of Rochester, N. Y.

I have looked over, somewhat hastily, the work on the "Progress of our Country." The plan seems to me excellent, the idea of presenting in a short compilation the present state and rate of progress of the various industrial arts is one which can not fail to be thought worthy. In general, the work seems to be successfully and correctly done. In such a work it is impossible to avoid errors, and the prejudices and interests of the different compilers may be occasionally seen. Notwithstanding this, the work seems to me well worthy the patronage of the public.

No. 9.

From the President of Brown University, Providence, R. I.

I have examined those parts of the " work on the Progress of the United States" on which my studies and observation have enabled me to form an intelligent judgment, and find, compressed within a small compass, a vast amount of valuable information, well selected and well arranged. It furnishes ample means of comparison on the subjects of which it treats, and will, I think, prove to be a valuable book of reference.

No. 10.

From President University of Wisconsin.

I have examined, with a pleasure I can hardly express in too strong terms, your " work on the Progress of the United States." During the few days the work has been on my table it has saved me, in the examination of facts, labor worth many times the cost of the volume. For the school library the business man, the scholar, or the intelligent family, it will be found a cyclopædia presenting, in a most interesting form, the progress of the various arts of civilized life during the period of our national existence. I most heartily recommend the work.

No. 11.

From the President of Columbia College, N. Y.

*Sir*,—I thank you for the copy of a work on the "Progress of the United States," published by you.

It seems to me of great value as containing information of interest, more or less, to all, and not easily accessible, except to varied labor and research.

The idea, too, of illustrating national progress, not by war, nor annexation, nor diplomatic legerdemain, but by the advance in the institutions of learning, in useful inventions, in the growth of manufactures, agriculture, and commerce, in all the arts of peace, in morals and civilization, in the inner life, so to speak, of the people themselves, seems to me both original and founded in the true notion of progress.

I trust you will derive abundant reward for your praiseworthy adventure.

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No. 12.

From the President of Tufts College.

MR. STEBBINS: *Dear Sir*,—I was led to expect much from the title of your work, on the "Progress of the U. S.," and resolved to give it a careful examination. I have been richly repaid for the time thus spent, in the great pleasure and profit I have derived from its perusal. Heartily thanking you for this generous contribution to generous knowledge, I trust you may reap a rich reward for your efforts.

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No. 13.

From the President of Dartmouth College.

L. STEBBINS, ESQ.: *Dear Sir*,—I received some days ago your very handsome work, a history of the "Progress of the United States," but have found leisure only within a day or two to examine its contents. Those persons who have been longest on the stage can best appreciate the amazing contrasts in the state of the country which you describe, but one who, like myself, can recognize the history of half the period, can testify to the faithfulness and fullness of your exhibition of the growth and power of this great country.

Accept my sincere thanks for the work, and the opinion that on the subjects treated it will be found an invaluable authority by all who study its pages. I trust it may have an extensive distribution.

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No. 14.

From Chancellor State University of Michigan.

MR. STEBBINS: *Sir*,—I have the honor to acknowledge the receipt of a copy of the work recently published by you, entitled "260 Years' Progress," for which please accept my hearty thanks.

It was not to be expected that this work could be made to contain an adequate view of the progress of our country during eighty years. But you have presented the public with this large work, filled with interesting and valuable matter on this subject, as much, perhaps, as could be compressed into it. I hope this work will find a wide circulation, and thus become a public benefit in a literal sense.

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No. 15.

From the President of the Vermont University, Burlington.

I have only had time to dip into your "260 *Years' Progress*" here and there. But I have been pleased and instructed, and am sure the book must be very valuable. My children are very much interested in it.

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No. 16.

From the President of Williams' College.

*Dear Sir*,—I have no hesitation in saying that the work proposed to be done in the "260 *Years' Progress*" has been well done. For those who wish a book of the kind, yours cannot fail to be *the* book.

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No. 17.

From President of Trinity College, Hartford, Conn.

*Dear Sir*,—I have to thank you for a copy of your work on the Progress of the United States. It treats of some matters with which I am familiar, and of some with which I am not familiar: but I think I can honestly say, with regard to both, that they are so presented as to be at once interesting and instructive to the general reader.

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No. 18.

Pres. Yale College, New Haven, Conn.

YALE COLLEGE,

MR. L. STEBBINS: *Dear Sir*,—Your book is a good and useful one, but it is not my practice to recommend books.

No. 19.

College of New Jersey,
Princeton, *Jan.* 28,

*Dear Sir,*—Your "work on the Progress of the United States." I regard as a valuable publication, richly meriting the attention of the general reader, as well as the more careful examination of the student interested in observing the advancement of our country in the useful arts and learning.

Very respectfully yours,
John McLean.

L. Stebbins, Esq.

No. 20.

From Prof. Johnson, Yale College, New Haven, Conn.

L. Stebbins, Esq.: *Dear Sir,*—I have examined "260 Years' Progress," with interest, especially the excellent chapter on agriculture. In my opinion, the work is one of much value, and deserves a wide circulation. Yours, etc.,

S. W. Johnson,
Prof. of Analytical and Agricultural Chemistry in the Sheffield Scientific School of Yale College.

No. 21.

From Rev. Dr. Smith, Lane Theological Seminary, Ohio.

Mr. L. Stebbins: *My Dear Sir,*—I have run my eyes with great interest over your beautiful work, "a history of *Progress.*" It contains, in a condensed yet attractive form, a mass of information touching the progress and present condition of our country. It is, moreover, information of which every man, at some time, feels the need; and it would be a grand contribution both to the intelligence and patriotism of our whole population, if you could succeed in placing a copy of it in every family of the land. I shall place your book on my table for constant reference.

No. 22.

From Professor Fowler, of Amherst College, Editor of the University Edition of Webster's Dictionary, Series of Classical Books, etc.

The work which you placed in my hands, "great wealth producing interests of our Country," I have taken time to examine, in order that I might learn its intrinsic value. I find that the subjects selected are such, and the manner of treatment such, as to supply a felt want in the public mind, which, in its own progress, was demanding higher and better help than it enjoyed before the publication of your work. This might be inferred from the bare mention of the subjects and the authors. These subjects are treated by these writers with that correctness of the statement of the general principles, and with that fullness of detail which make the work just what it ought to be as a guide to the people. Every young man who wishes to elevate his mind by self-culture, ought to read this work carefully.

Yours respectfully,
William C. Fowler.

No. 23.

From Prof. Silliman, Yale College, New Haven, Ct.

I have carefully looked through your rich and faithful work, observing the copious tables of contents, glancing at every page of the work, and at all the numerous illustrations, with occasional reading of paragraphs. A more thorough examination it has not been hitherto in my power to make; but even this general survey has left on my mind the decided conviction that you have performed an important service to your country in thus mapping out and condensing and explaining the wonderful progress made in this country, during four-fifths of a century, in all the most important arts of life. My own recollections—my years having been coeval with the entire period covered by your work—sustain your statements regarding the extreme simplicity of our early domestic arts—cheap in mechanical aids but prodigal of time. Now productive industry, aided by successful inventions, fills all our regions where free labor has full scope for action, with innumerable results which are fully equal to our wants, even in the present crisis, leaving also a large redundancy of articles for export, especially in the department of agriculture, and in not a few important mechanical arts.

Your work of closely printed pages of double columns, with a fair paper and a clear and distinct type, with its numerous engravings, defended also by a strong and neat binding, presents a valuable book of reference; a manual to be consulted by the agriculturist and artist, as well as by the man of science and the historian of progress. Wishing to yourself and your worthy coadjutors full success,

No. 24.

From the New York Times.

260 years "Progress of our Country."—If at all inclined to doubt that a great deal of useful information may be bound up in a comparatively small compass by a judicious compiler, in the very handsome work before us, we should find sufficient logic to make us devout believers. The writers have ranged through the wild fields of agriculture, commerce, and trade; very little that develops the material prosperity of a country, and marks its growth, has escaped their industrious research. Undoubtedly, minute criticism might detect slight errors, but in a work of so comprehensive a character, strict accuracy would seem almost unattainable. The statistics given are full and clearly arranged; the grouping of the subjects, and the evident method which the authors have observed in the accomplish-

ment of their not inconsiderable task, are worthy of all praise. The work is one which we particularly need, as it is a lamentable fact that few people are so deficient in general knowledge of facts relative to growth and development of their native country, as ours. The Englishman generally has an arsenal of statistics at his fingers' ends; he can tell you when the first shaft was sunk in the first mine; when the first loom was erected in Manchester. The panoply of facts in which he is arrayed makes him rather a ponderous and far from sprightly companion, at times; but then he always proves formidable as an adversary. Germans, too, have nearly every thing by rote that relates to their own country. Frenchmen are quick to learn, but they have not very retentive memories generally, and are very apt to forget all, and more, than they once knew. It may be urged in extenuation of our national delinquency, as regards a knowledge of our own country, that our country grows too fast for our memories to keep pace with it, and that a Yankee can arrive by guessing at what others, less favored in this respect, can only reach by delving in authorities; but, on the whole, it is better to trust to actual knowledge of facts, and under any circumstances such books as these are good things to have in the library.

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No. 25.

From the New York Examiner.

260 *Years' Progress of the United States*," by eminent literary men, who have made the subjects of which they have written their special study.

The citizen who desires to comprehend fully how the country in which we live has, under the fostering influences of a good government, the enterprise of an energetic people, and above all, the blessing of God, grown from a handful of people to one of the leading powers in the world, should purchase and read carefully this work. It is no catchpenny affair. The men who have prepared the narratives of progress in the various departments of agriculture and horticulture, commerce, manufactures, banking, education, science, art, and the matters which go to make "home" so emphatically an American word, are not novices, penny-a-liners, who write on any or all subjects, with or without an understanding of them, for the sake of their daily bread —but men of high reputation, who have made the subjects they discuss the topics of a life's study. Every subject which will admit of it is finely illustrated, and tables of statistics, carefully prepared from the latest sources, show the present condition of each department, and demonstrate, as only figures can, how great the advance which has been made in each. As a work of reference, not less than as a deeply interesting book for family reading, it will be a treasure to any household that may obtain it.

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No. 26.

From the New York Observer.

260 *Years' Progress of the United States*."—the above rather formidable title-page is quite a full exposition of the contents of this large work, which contain a vast amount of scientific, historical, and statistical matter, and which constitute a valuable encyclopædia, as well as history of the progress of the country, during the last eighty years. Many of the most extended articles are by eminent scientific and practical men, who have devoted themselves largely to the subjects on which they have written.

The subjects are not treated briefly, but in detail, rendering the work valuable as a book of reference as well as for general reading. Such a review as we have in this work may well excite wonder, gratitude, and hope. The history of no other country can furnish a parallel.

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No. 27.

From I. SMITH HOMANS, Secretary of the Chamber of Commerce of the State of New York.

260 *Years' Progress of the United States*."—The first eighty years of the national existence were illustrated by no brilliant military exploits, such as for the most part make up the history of most countries of the Old World, but the American people did not the less on that account assume a marked character, and a first rank among the nations of the earth. Their success in ship-building and commerce at once placed them on a level with the greatest maritime nations. The inventive genius and untiring industry of the people soon revolutionized the manufacturing industry of the world, by the ready application of new mechanical powers to industrial arts; and if the extent and cheapness of land for a time supplied the scarcity of labor in agricultural departments, it did not prevent the multiplication of inventions, which have not only added immensely to home production, but have greatly aided that of European countries. The development of these industries forms the true history of American greatness, and the work of Mr. Stebbins has given a world of information upon each branch of the subject, in a most authentic and attractive form. The chapters on ship-building, commerce, and internal transportation, present to the reader a mass of valuable information as astonishing for the magnitude of the results produced as interesting in the narrative. We know of no other work which, in the compass of two handsome volumes, contains such varied and comprehensive instruction of a perfectly reliable character. They form almost a complete library in themselves.

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No. 28.

From the Secretary of Board of Trade, Philadelphia.

L. STEBBINS, ESQ.: *Dear Sir*,—I examined with interest the volumes published by you, on the "Progress of our Country," and found them particularly valuable. The design struck me very favorably, and the execution of the several parts could not have been intrusted to more competent hands. The last eighty years of the history of the United States has been one of unexampled progress, and it is now more than ever important to bring in review before the people of every section the leading facts of this marvellous progress.

No. 29.

From the Secretary of the Board of Trade, Boston.

*My Dear Sir*,—My many cares just now have prevented me from a comparison of the statistical matter contained in the "work on our" *Progress*," with official tables in my possession, as well as an examination of some other things, concerning which authorities differ, but I *have* found time to acquaint myself with the general topics and objects of the work, and do not hesitate to declare that I have not read more interesting pages for years. Indeed, the best informed among us, cannot, as it seems to me, fail to find much that is new, while to the young and to those who lack the means of research, so authentic and well-digested account of our country's "Progress," will be of immense service. We all boast of our wonderful march in commerce, in manufactures, in mechanics, and in the arts; and here we have it, step by step, in "facts and figures," and in brief and pithy narrative.

With all my heart, I hope that the sale will be extensive, and that you may be well rewarded for your outlay of time and capital.

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No. 30.

From the New Englander, New Haven, Conn.

"260 *Years' Progress of the United States.*"—In this very large octavo work there is presented in a compact and easily accessible form an amount of valuable information with regard to the progress which the people of the United States have made in all the various channels of industry since the days when they were British colonists, which is not to be found in any other single work with which we are acquainted. Each one of these subjects is amply illustrated with engravings. The different chapters have been prepared by well-known literary men who have each made the subjects about which they have written the study of years. We have examined the work repeatedly and with much care during the past three months, and each time have been impressed anew with its value. There is not an intelligent family in the nation who would not be interested and instructed by it, and find it a most convenient book of reference with regard to every thing pertaining to the industrial interests of the country.

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No. 31.

From the Philadelphia Inquirer.

"260 *Years' Progress of the United States.*"—To any one desiring at a glance a comprehensive view of the various channels of educational industry in commerce, manufactures, agriculture, statistics, etc., they are invaluable. They are profusely illustrated with elegant engravings in the highest style of artistic merit. The volumes redound with statistical and miscellaneous information of a standard character and permanent value. The expense of publishing a work of this character must have been very large, but we feel confident that a discriminating public have not been overestimated.

There are among the peculiar characteristics of our people, wide-spread opinions prevailing, that books sold by subscription are of a necessity more expensive than when purchased in a general way at the counter of a publishing house. This is evidently an error that could easily be subverted by a little demonstration, and the publishers' remarks in the preface are to the point, and effective. We know of hardly any book or books which are within the reach of every-day life, that we would sooner advise a friend to purchase. Its value will be unimpaired for a lifetime.

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No. 32.

From the Boston Transcript.

"260 *Years' Progress of the United States.*"—This work is the result of much careful research, exercised by many minds on a variety of important subjects. They show the industrial and educational steps by which the people of the United States have risen from their colonial condition to their present position among the nations of the world. They give, in a historical form, the progress of the country in agriculture, commerce, trade, banking, manufactures, machinery, modes of travel and transportation, and the work is intended to be sold by subscription, and will doubtless have a large circulation. It ought to be in every house in the land. It is more important than ordinary histories of the country, as it exhibits all the triumphs of the practical mind and energy of the nation, in every department of science, art, and benevolence. It is a storehouse of important and stimulating facts, and its interest can hardly be exhausted by the most persistent reader.

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No. 33.

From the N. Y. Herald.

"260 *Years' Progress of the United States*," by eminent literary men.—The object of this work, as set forth in its preface, is to show the various channels of industry through which the people of the United States have arisen from a British colony to their present national importance. This is done by treating separately the improvements effected in agriculture, commerce, trade, manufactures, machinery, modes of travel, transportation, etc. The preparation of these different articles has been intrusted to writers whose pursuits qualified them to handle them exhaustively, and the result is the assemblage of a vast amount of statistical and other information which is not to be found in the same collective and condensed form in any other work extant.

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No. 34.

From the Boston Post.

"260 *Years' Progress of the United States*, showing the various channels of industry through which the people of the United States have arisen from a British colony to their present National Importance," is the title of a new and exceedingly valuable work. The work gives in a historical form the vast improvements made in agriculture, commerce, trade, manufacturing, etc., together with a large amount of statistical and other information. It is illustrated with numerous engravings, and altogether forms a most valuable and instructive companion to the writer, the business man, or the student

No. 35.

From Wm. W. Turner, Principal of the American Asylum for Deaf and Dumb, Hartford, Conn.

I have examined your new national work, on the development and "Progress of the United States," and find that the information it contains on the wide range of subjects treated of must make it exceedingly valuable as a standard book of reference. The names of the writers of the different articles afford a sufficient guaranty that the facts and statements may be relied on as correct. I consider the work a very important accession to this department of literature, and have no doubt that it will find its way into the library of every private gentleman and every public institution.

No. 36.

From Superintendent Common Schools, Massachusetts.

I have examined the *Encyclopedia of Progress"* with satisfaction. I consider it a work of great value, and it is one which I should be very unwilling to spare from my library. It is not only such a book as the literary or professional man would like to possess, but it is a book for every household, and for every school library.

No. 37.

From the Boston Journal.

" 260 *Years' Progress of the United States."*—In this elaborate and valuable work the progress of the United States is illustrated by historical sketches of the rise and development of agriculture, commerce, trade, manufactures, modes of travel and transportation. The authors will be recognized as fully competent to treat upon the above subjects, and their sketches have great interest and value, as well for the facts which they present, as in illustrating the rapid progress of the United States in all that conduces to material wealth and national prosperity. The work abounds in valuable statistical information, and is interesting for perusal, and useful for reference.

No. 38.

From the Philadelphia Evening Journal.

" 260 *Years' Progress of the United States,"* by eminent literary men.—The work treats of the various channels of industry through which the people of the United States have arisen from a British colony to their present national importance. It treats of the vast improvements made in agriculture, commerce, trade, manufacturing, machinery, modes of travel and transportation, etc., etc.

No. 39.

From the Homestead, Agricultural Journal,

" 260 *Years' Progress of the United States."*—The title conveys but a faint idea of the great amount of information contained in these volumes, and no cursory glance can more than convince the reader that they possess great value as an encyclopædia of arts and progress in civilization. The names of the authors of the more important articles, several of whom are known to us personally and highly respected, are a guaranty that their work is well done, and statements reliable. Our limited space forbids an extended notice, but before noticing especially the agricultural departments, we must add, that to every one who takes it up it is one of the most fascinating of books, a most remarkable quality in a book so statistical in its character.

The article of progress in Agriculture is by Chas. L. Flint, Secretary of the Massachusetts Board of Agriculture, and is a most able and interesting collection of facts in regard to the remarkable progress of this country since the Revolution.

No. 40.

From the Philadelphia Daily Evening Bulletin.

Mr. L. Stebbins,—After carefully examining your valuable publication, on the wonderful "Progress of the United States," and having on various occasions, in our professional business, tested its accuracy as a work of reference, we are able to bear testimony to its character. No work that we have ever seen gives such spirited, comprehensive, and correct views of the progress of our country in political strength, in commerce, agriculture, manufactures, and all branches of industry and art. The work has been prepared with extreme care; the various subjects are treated with intelligence, and the style of composition proves that the writers are men of education, who have thoroughly informed themselves on the subjects they discuss. The illustrations and the typography add much to the attractions of a work that should be in the hands of all who take an interest in the growth of our country, and feel a patriotic pride in its prosperity.

No. 41.

From the Secretary of Board of Education.

Boston, Mass., *Sept.* 6,

*Dear Sir,*—I beg leave to thank you for your noble work giving a history of our " Progress."

After such an examination as I have been able to give, I do not hesitate to pronounce it a work of unusual interest and value.

As a depository of facts illustrative of the progress of our country in the departments of industry, it is invaluable.

Its wide circulation, at this eventful period, cannot fail to arouse and deepen that patriotic love of our institutions which is the pressing demand of the hour.

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No. 42.

From City Superintendent Public Schools, New York.

Mr. L. Stebbins: *Dear Sir*,—The great pressure of official engagements has hitherto prevented my acknowledgment of the receipt of the very beautiful and interesting work, giving a history of the great "Progress of the United States." I have not had time to peruse them thoroughly, but take great pleasure in stating that, so far as I have looked into them, the plan and general execution of the work seem to me to be admirable, and well adapted to the wants, as well of the rising generation, as of our fellow-citizens generally. I cheerfully recommend it to the favorable regard of school officers, parents, teachers, and others, as a very valuable compend of scientific and historical knowledge, and as a work well worthy of a place in every school or private library.

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No. 43.

From the New England Farmer, Boston.

"260 *Years' Progress of the United States.*"—This volume contains an immense amount of valuable and interesting information concerning the rise and development of agriculture. commerce, trade, manufactures, travel and transportation, the arts, and other prominent interests of this country. This information is contained in a series of essays by gentlemen, either and all of whom will be recognized as competent to illustrate the subject upon which he writes.

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No. 44.

From Frank Leslie.

*After copying the entire title-page, the notice proceeds thus:*

Such is the comprehensive title of an elegantly printed work which covers a very wide range of subjects of special American interest. Tho work is, in fact, an industrial and statistical history of the country since its independence, encyclopædic in character and arrangement, but yet sufficiently complete for every practical purpose. It may be regarded as an epitome of the publication of the Census and the Patent Office, and of the proceedings of our Industrial Societies, compact in form, convenient for reference, and deserving a place in the hands of every reading and reflecting man in the country.

No. 45.

From Mercantile Agency, New York.

From a cursory glance at its contents I feel warranted in saying it possesses information of much value and usefulness to all classes.

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No. 46.

From the Evening Post, New York.

"260 *Years' Progress of the United States.*"—The range of subjects treated in this work is very full; the writers upon them are well selected with regard to specialties, and their manner of handling is always interesting, frequently thorough. The system pursued is not encyclopædic, but historical, and, so far as possible, exhaustive. The growth of our agricultural prosperity, with particular regard to improvements made in breeds and machinery, and the dissemination of scientific knowledge among farmers, is well recited, and this department forms one of the most attractive features of the book.

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No. 47.

From B. J. Lossing, the Historian.

*Sir*,—I have examined, with great satisfaction, your work devoted to the industrial *Progress of the United States.*" It is a work of inestimable value to those who desire to know, in minute detail, something more of the history of the country than the events of its political and industrial life as exhibited in the politician's manual, and the bold statements of the census; especially at this time, when the civilized world is eagerly asking what we are and what we have been, that the old governments may attempt to solve the more important question, to them, what we *will* be. Your work, in fact and logical prophecy, furnishes an answer of which any people may be justly proud. Surely, no nation of the earth has ever experienced such bounding progress as this; and in the last eighty years, as exhibited in your work, we see ample prophecies of the future, of strength, influence, leadership among the nations, such as the eye of faith employed by the fathers, dimly saw. No American can peruse your pages without feeling grateful for the privilege of being an American citizen.

I will use a very trite phrase and say, with all sincerity, I wish your work could go "into every family in our land," to increase their knowledge and to strengthen their patriotism.

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No. 48.

From the New York Journal of Commerce.

"260 *Years' Progress of the United States.*"—The plan is extensive, and appears to be judiciously carried out. The work is divided into departments, to each of which has been devoted his laborious attention, producing a readable, and at the same time valuable and instructive, summary of the advances made.